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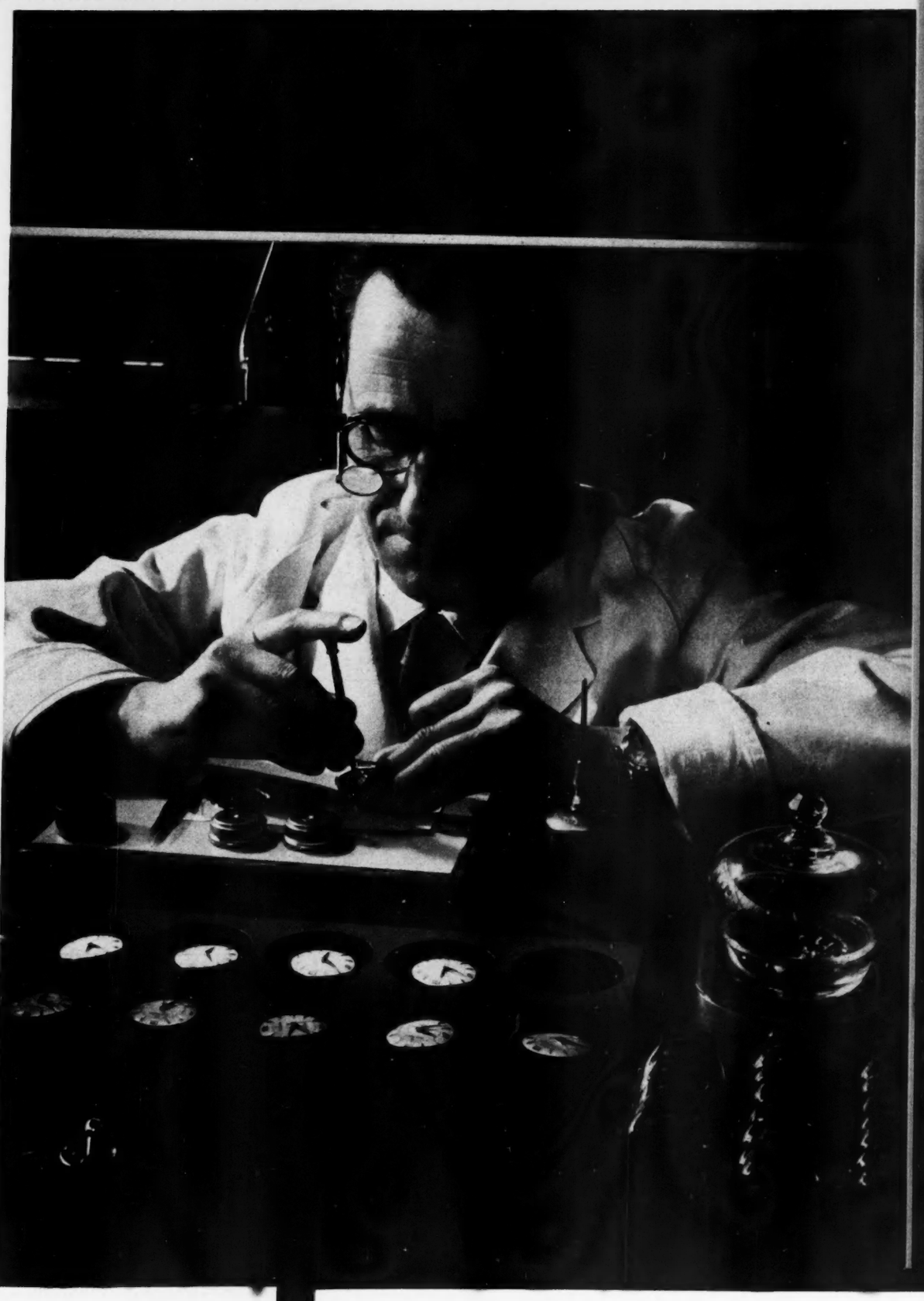

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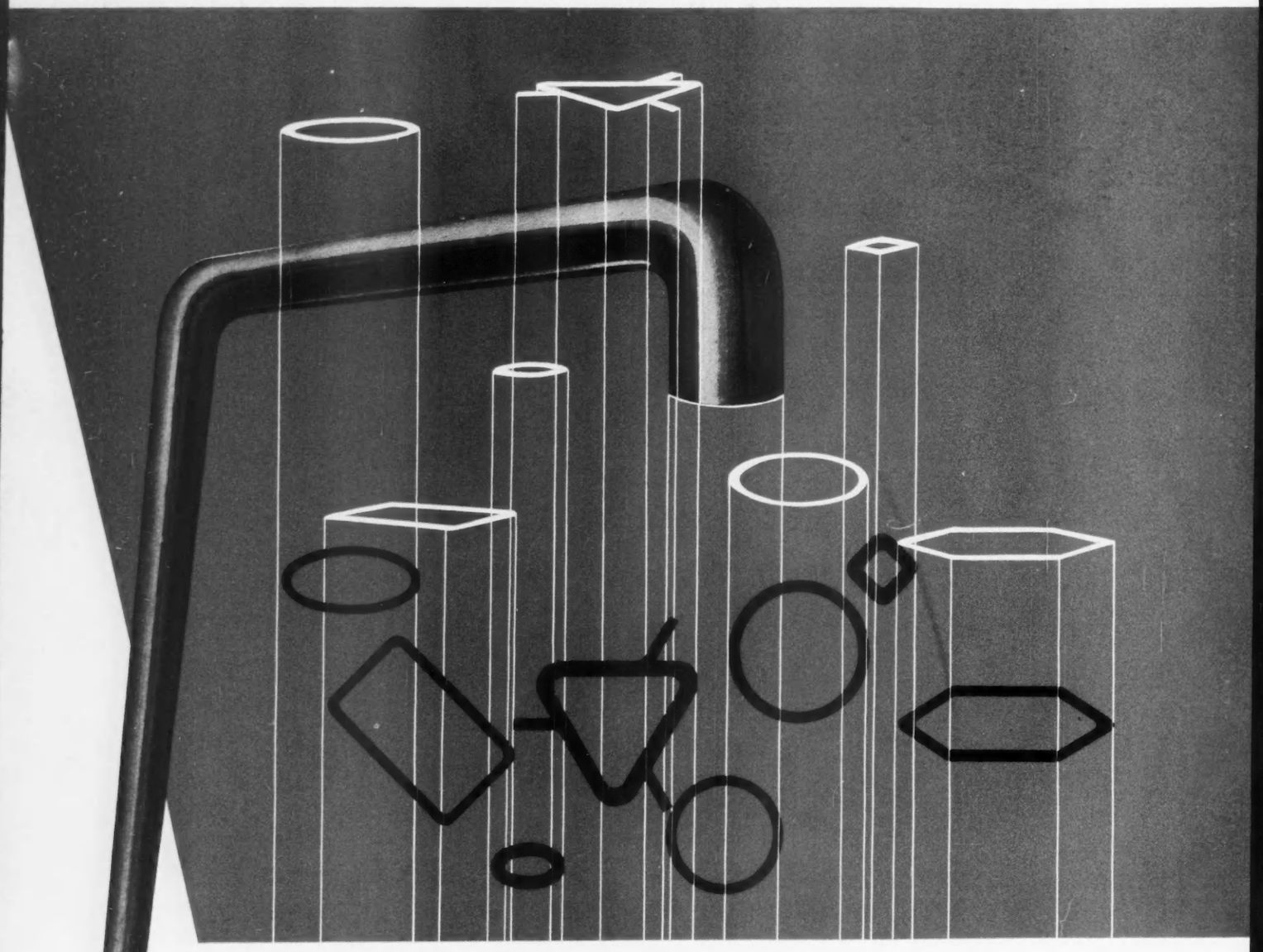

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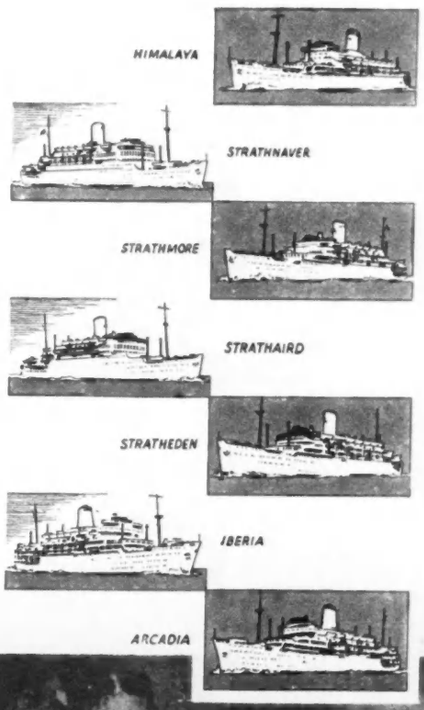

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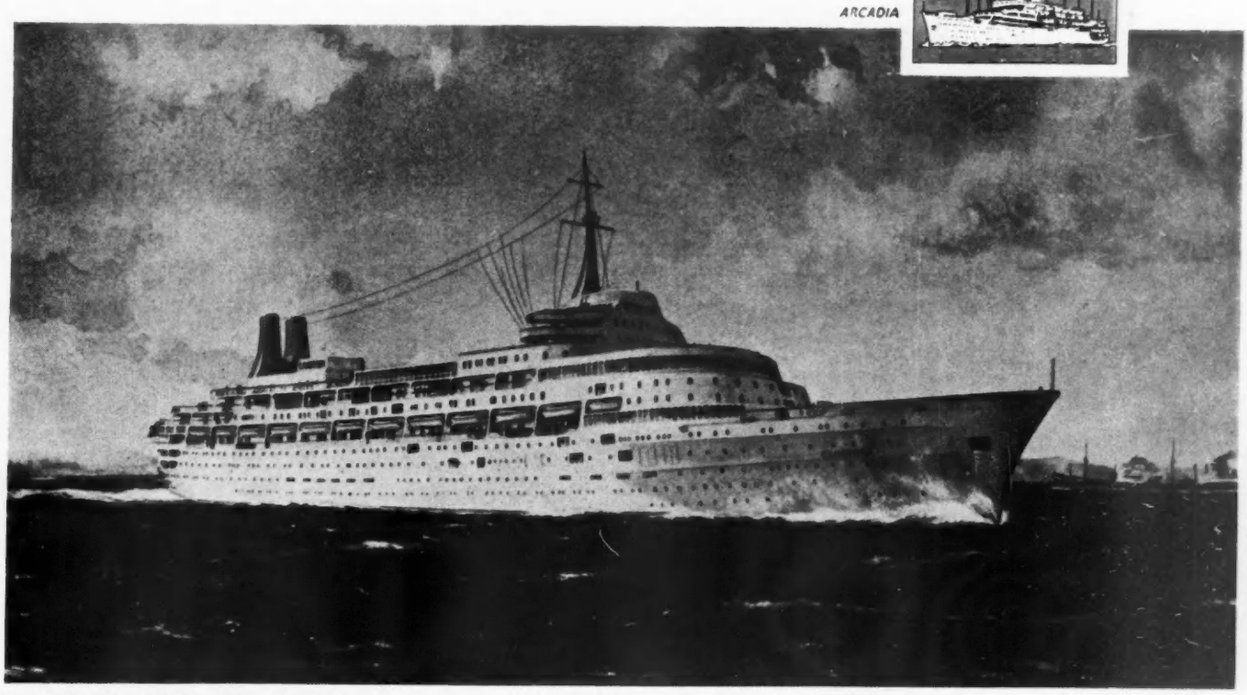

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Casing a high quality watch. The movement, already fitted with dial and hands, is being fixed into its case with casing screws and the back put on ready for timing. (*Nurnberg photograph for* ENGINEERING)

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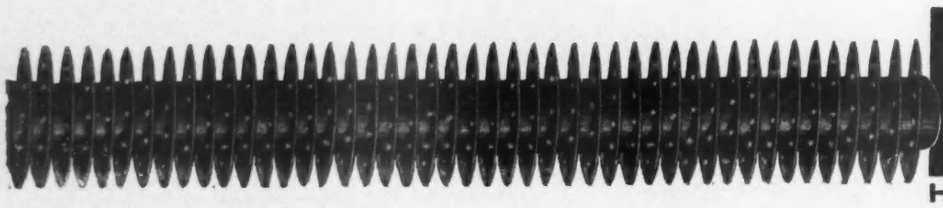

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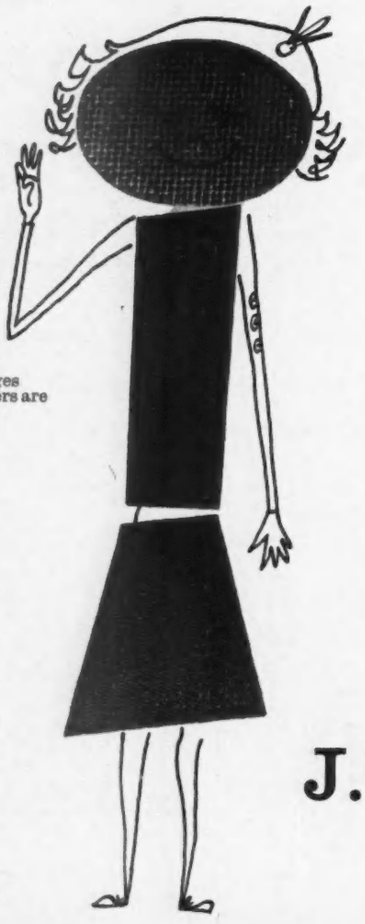

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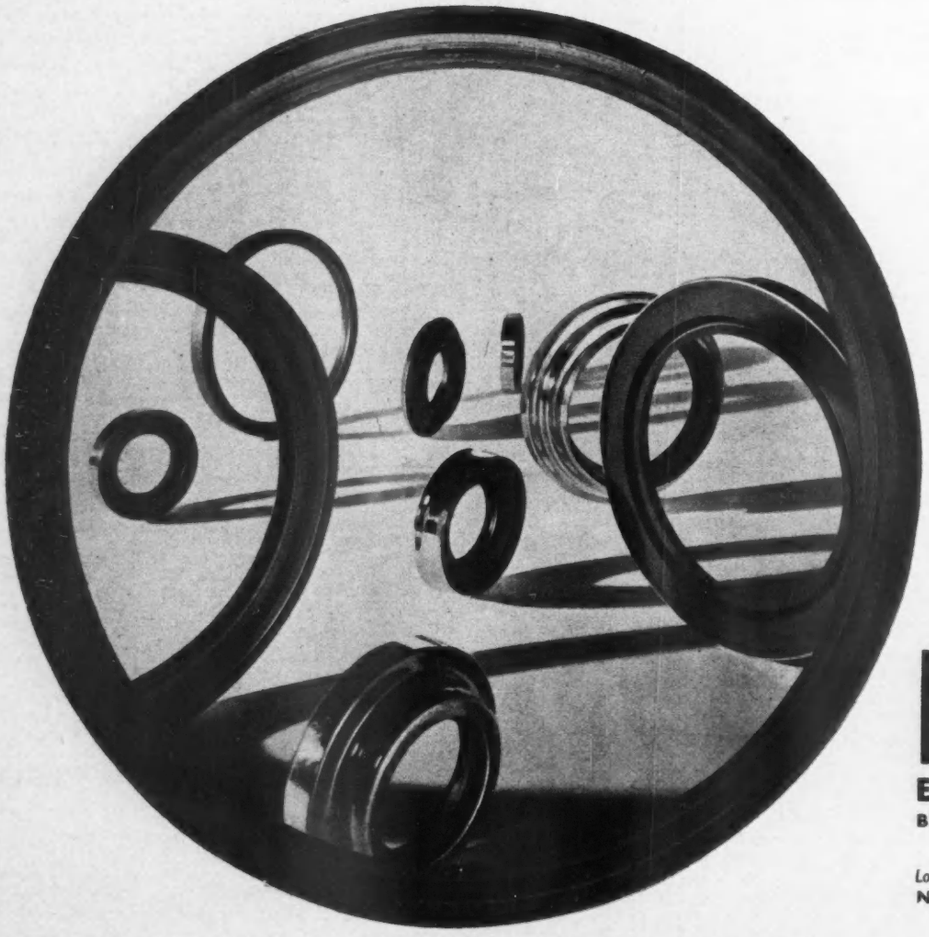

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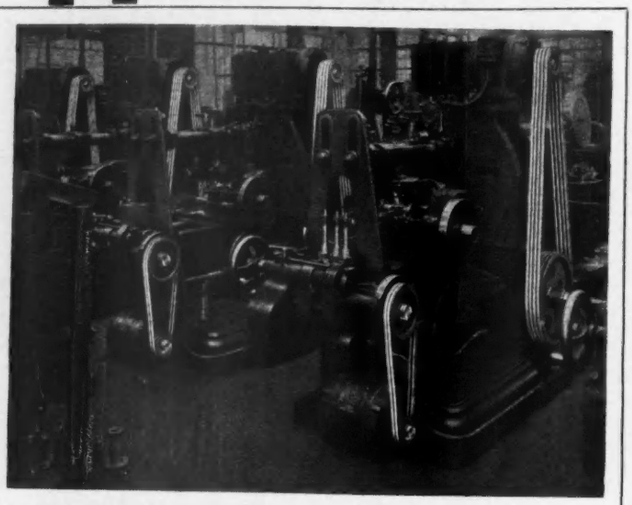

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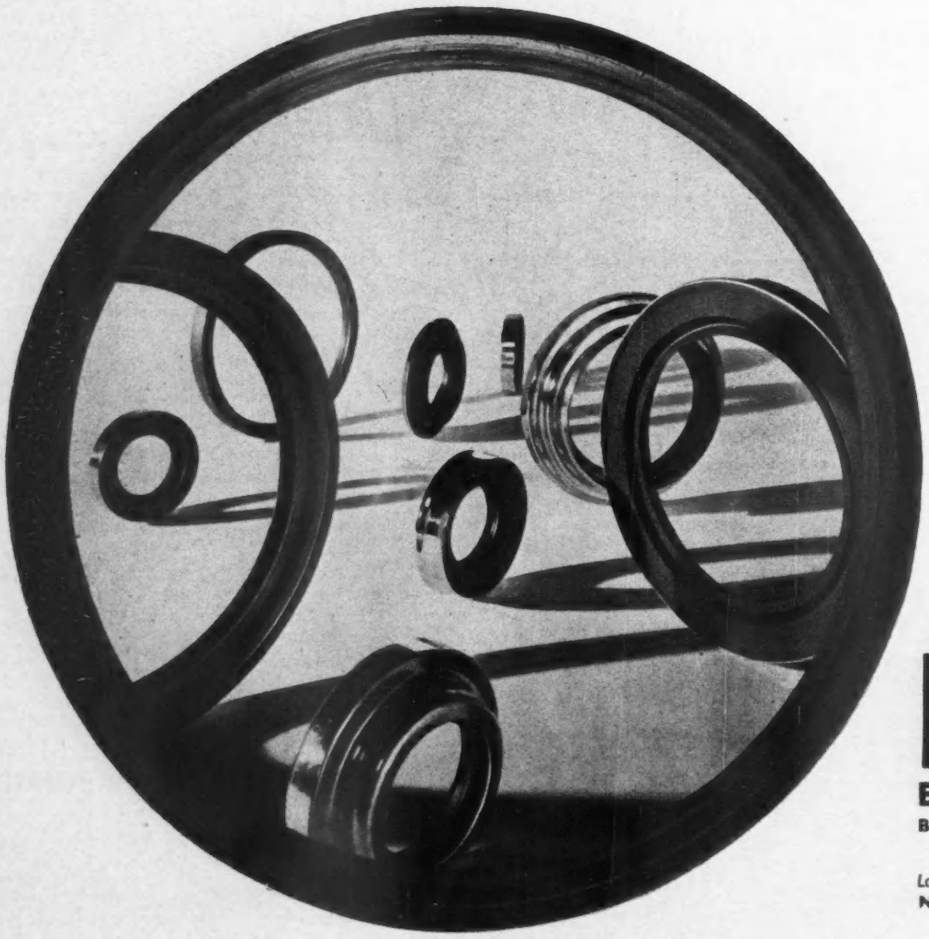

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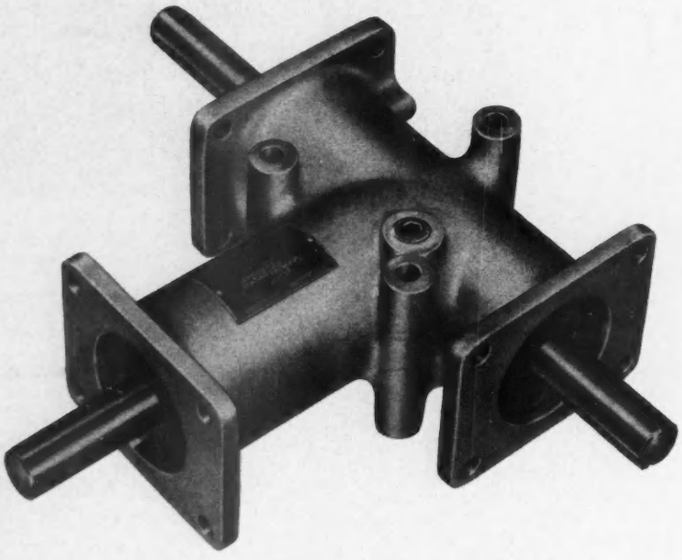

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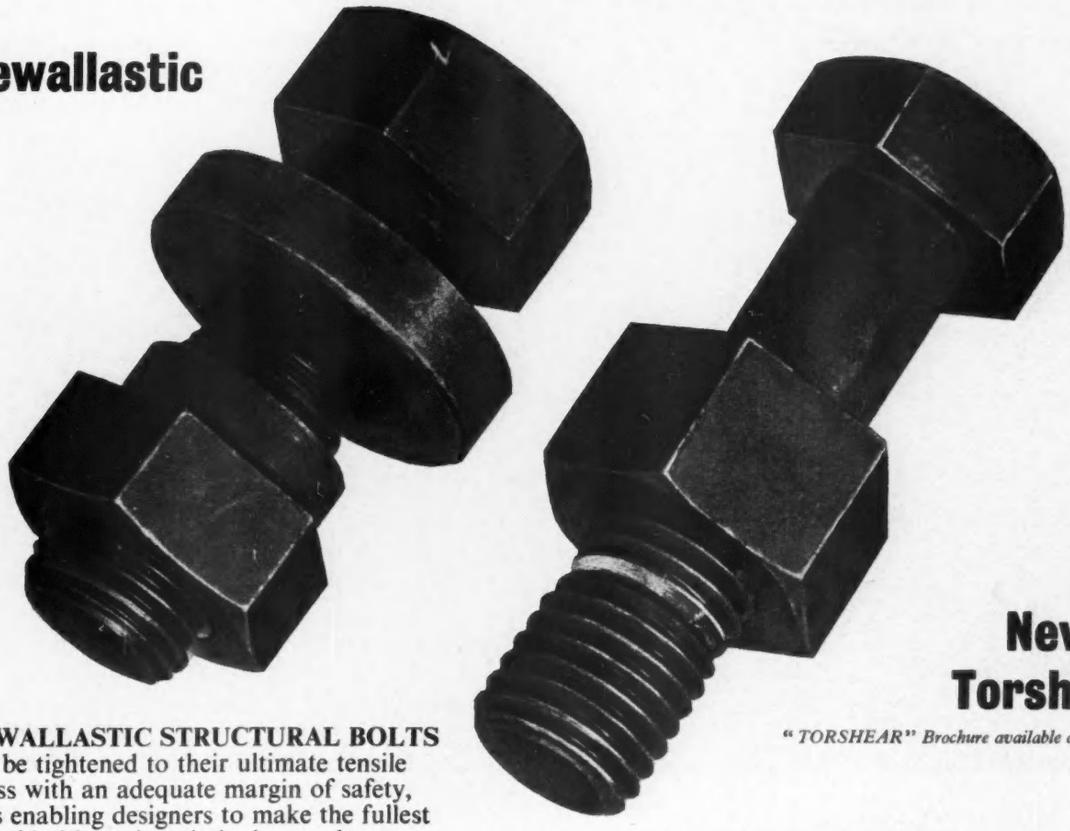

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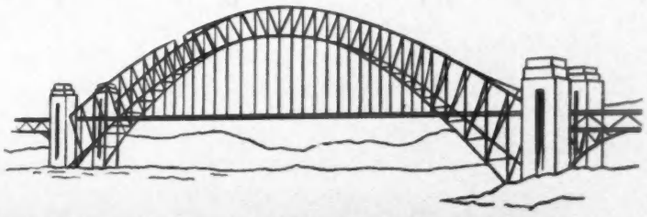

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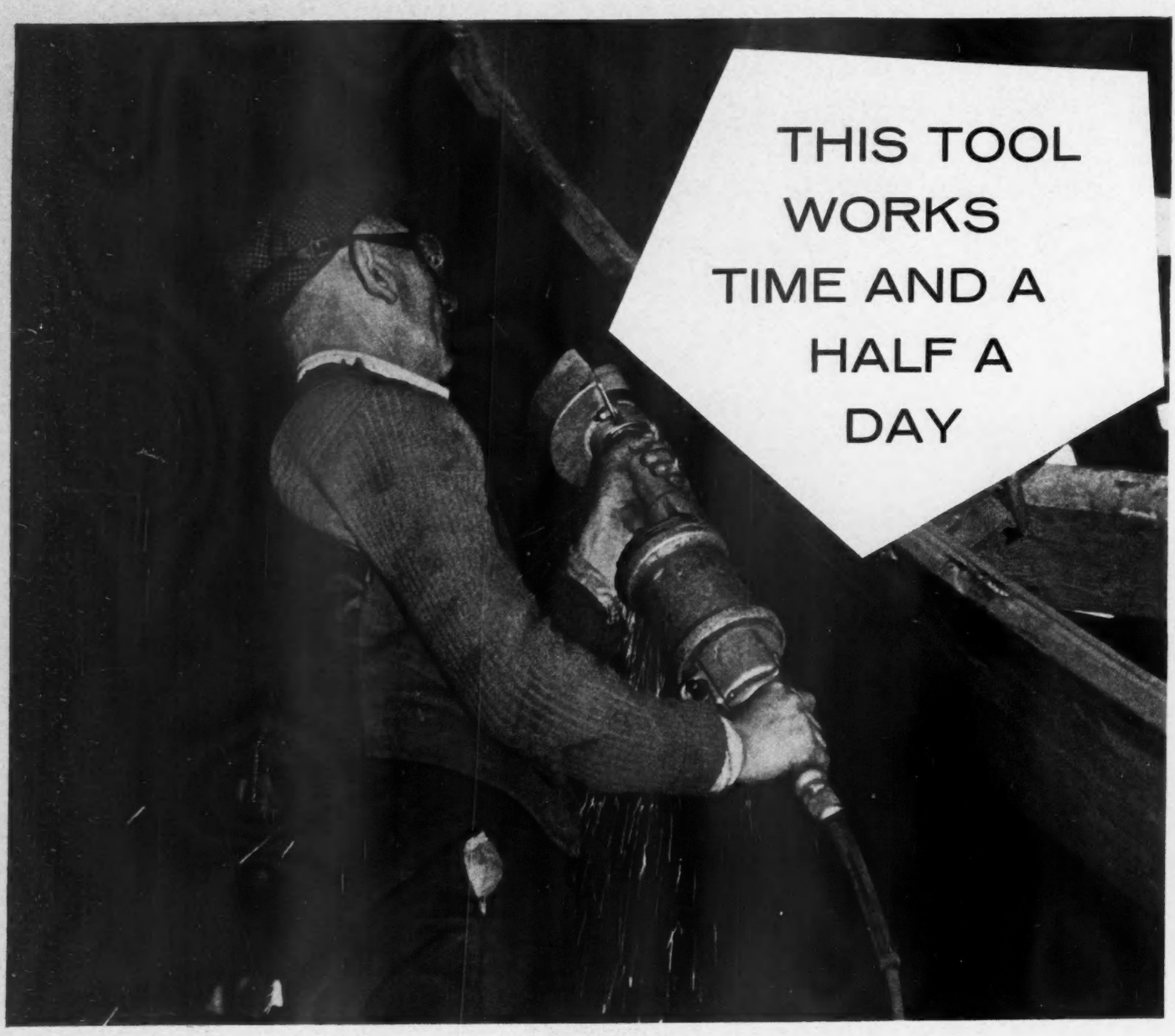

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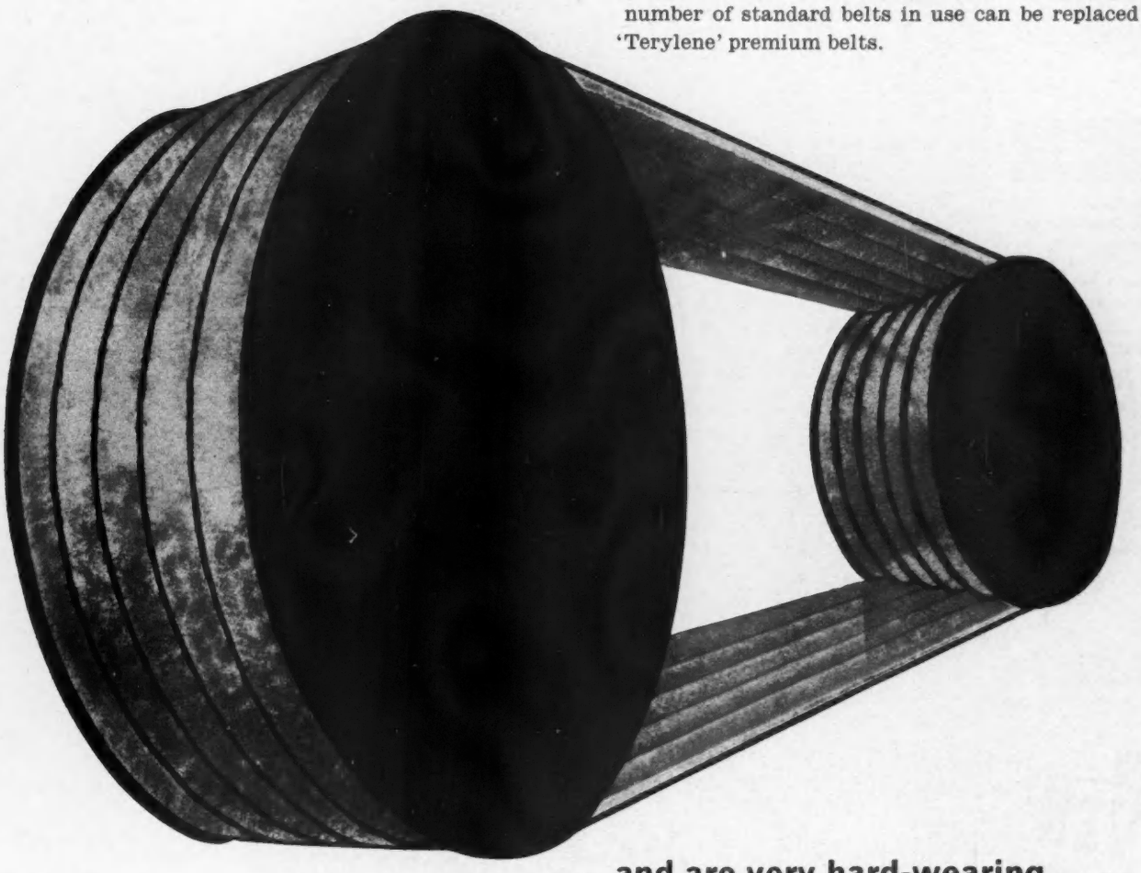

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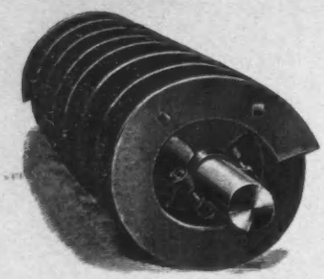

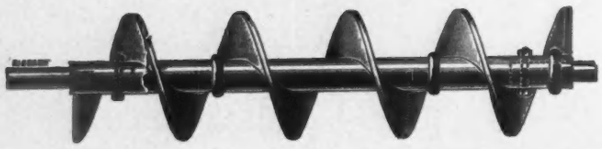

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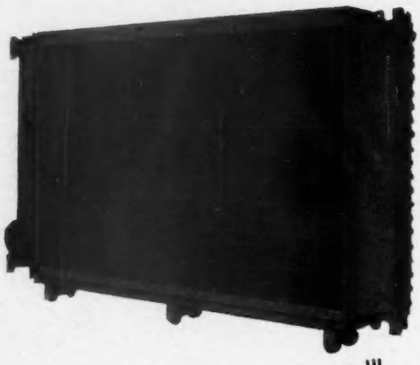

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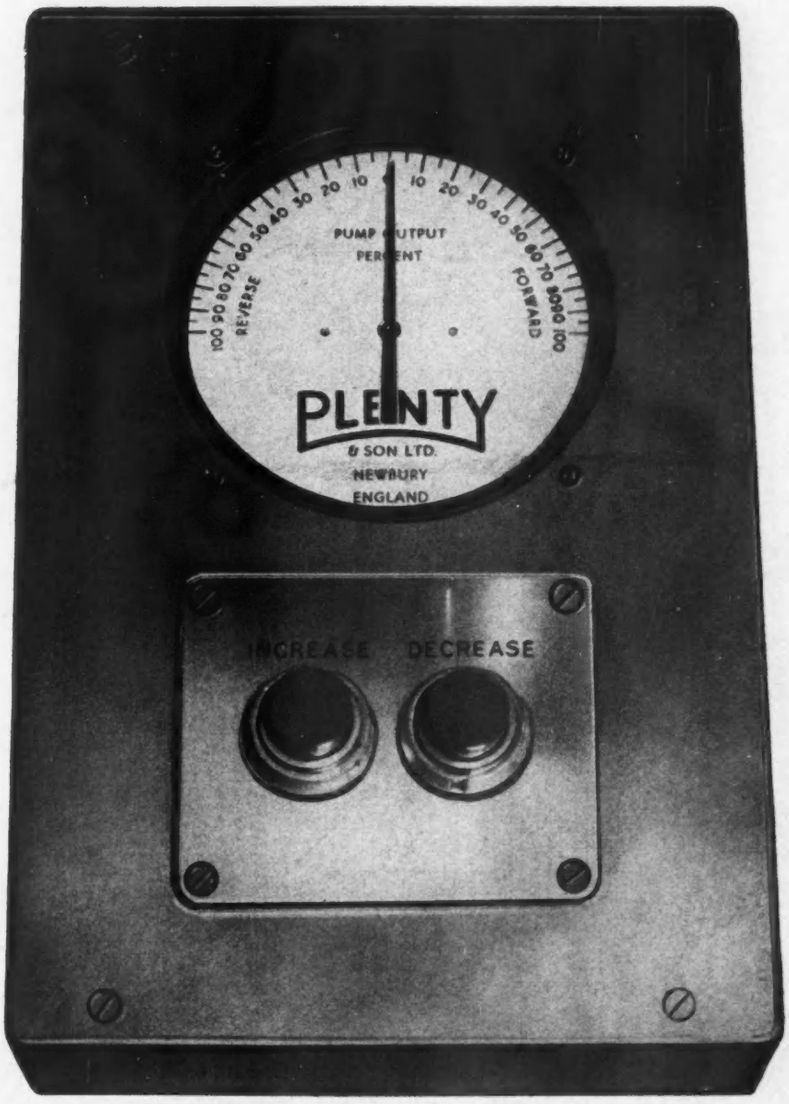

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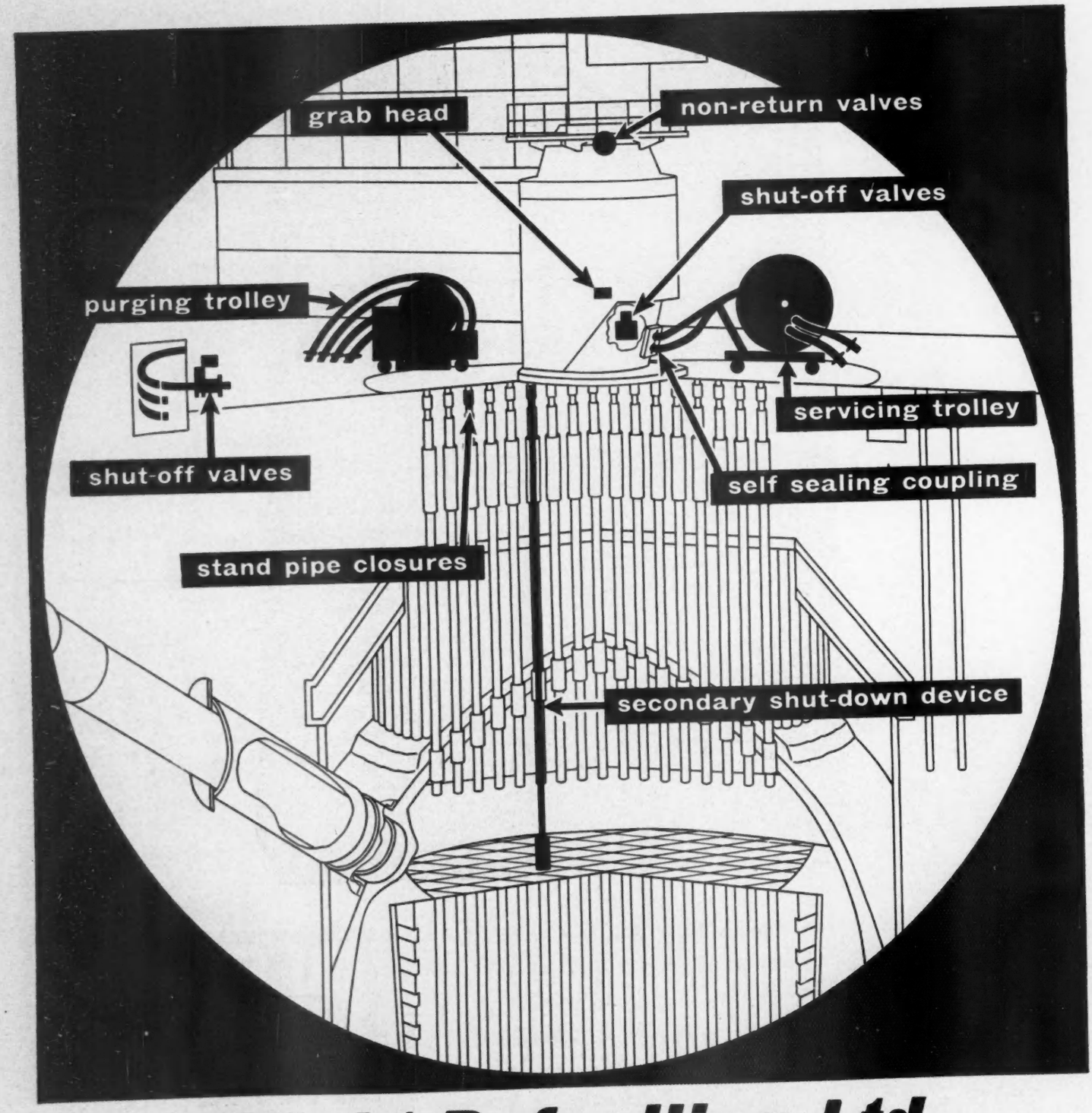

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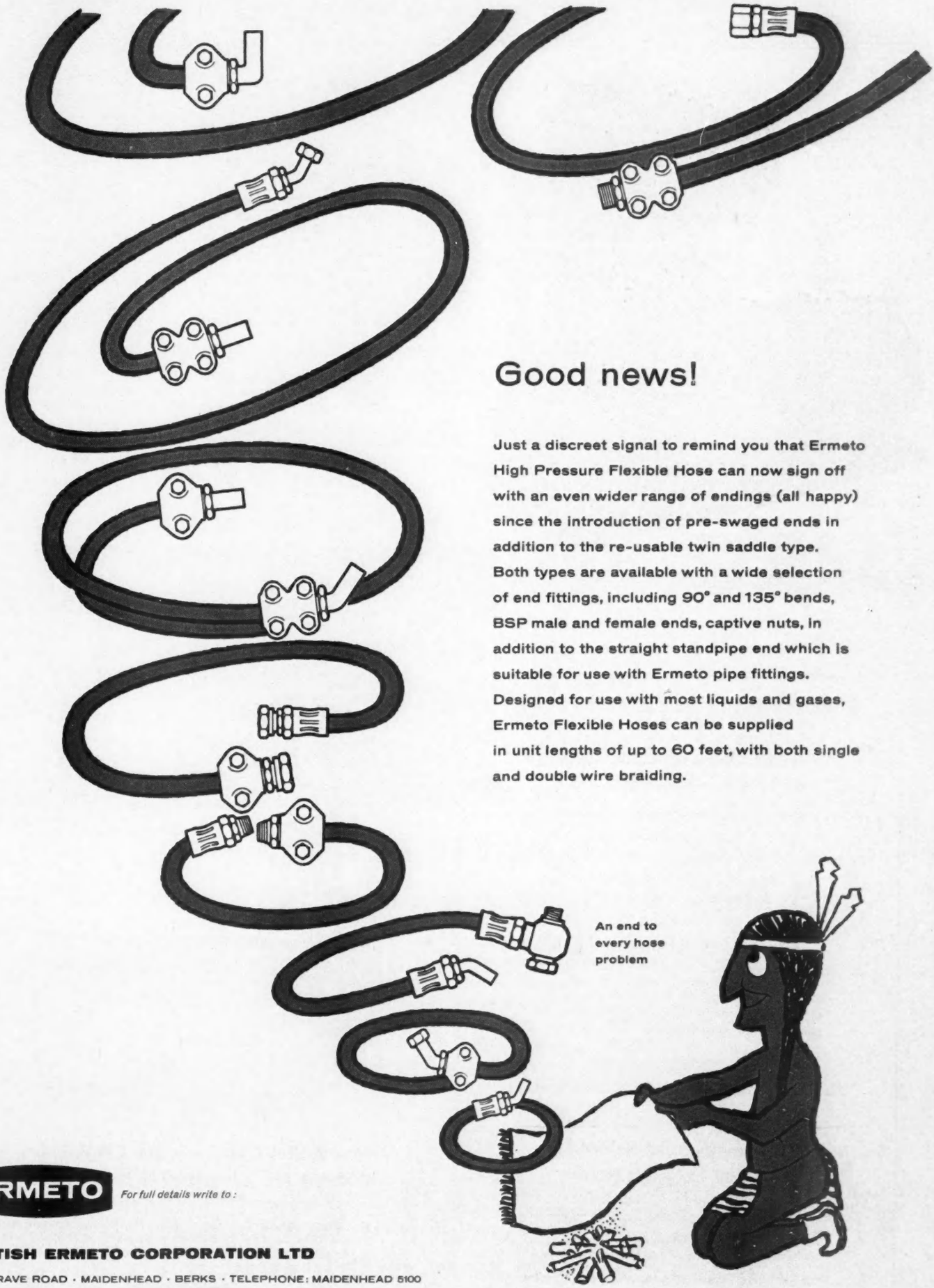

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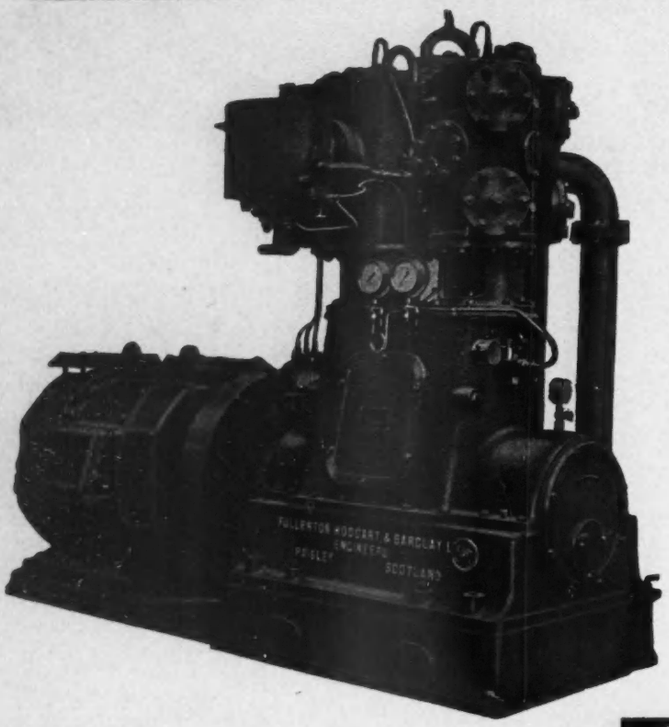

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Illustration shows
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Air Compressor
Capacity 500 cub. ft. free air per minute to a pressure of 100 lbs. per sq. inch. R.P.M. 360.

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The College of Aeronautics
offers courses at post-graduate level in

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Candidates for admission should be university graduates in engineering, science or mathematics or have attained that standard of education through engineering training and experience. The successful completion of a course leads to the award of the College Diploma.

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Goods to European Markets in through wagons every day

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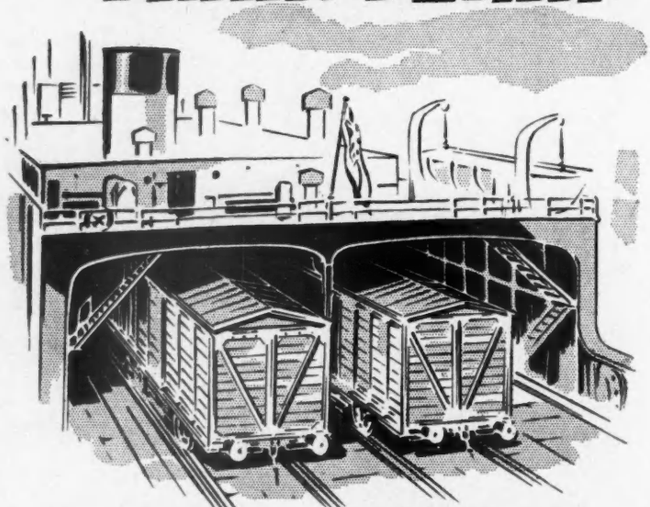

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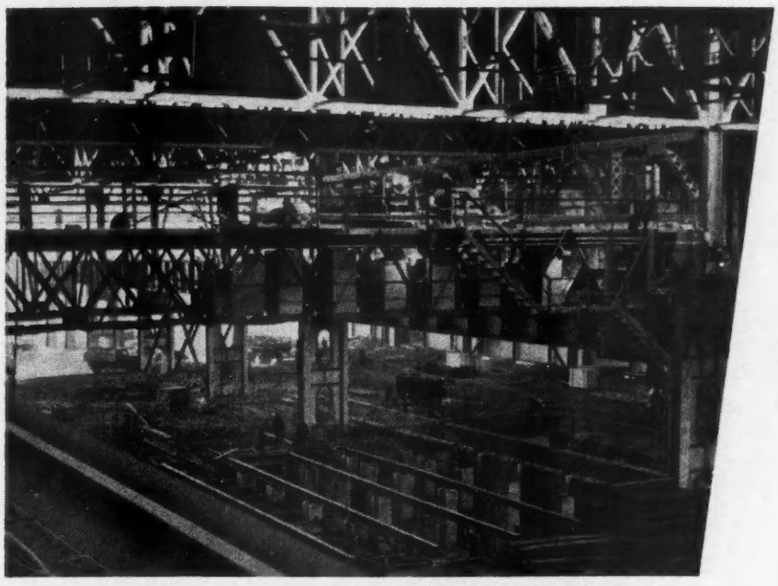

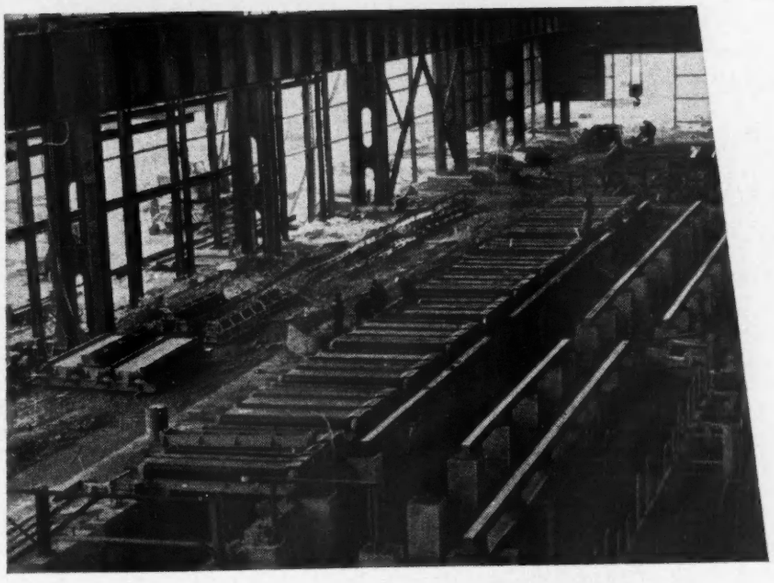

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in a £30,000,000 project to bring more prosperity to the North East

Already the foundations for the furnaces and heavy machinery for the new 4-high Plate Mill at Hownsgill, Consett have been laid and the vast network of stanchions, beams and girders forming the superstructure is rapidly taking shape. This is Consett's own Steel helping to pave the way to greater production and greater prosperity. The new mill at Consett will be capable of producing every week 10,000 tons of steel plate — plates of the highest quality. Consett is already famous for a variety of steels including special steels which have been developed in their own Research Department for use in Nuclear Reactors.

Consett is preparing to meet tomorrow's demands in steel—today!

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IRON COMPANY LIMITED

CONSETT, COUNTY DURHAM Telephone: 341 (12 lines) Telegrams: "Steel Phone Consett"

only FIRTH-VICKERS make

F.V. 520 steel provides a unique combination of properties. It possesses the weldability and corrosion-resisting characteristics of the 18/8 chromium-nickel stainless steel, and at the same time is capable of being heat treated to give high mechanical strength.

It is used extensively in the aeronautical field and is finding ever increasing applications for general engineering purposes.

F.V. 520 steel is produced in the form of bars, forgings, sheet, strip, castings and centrispinnings. Technical literature is available on request.

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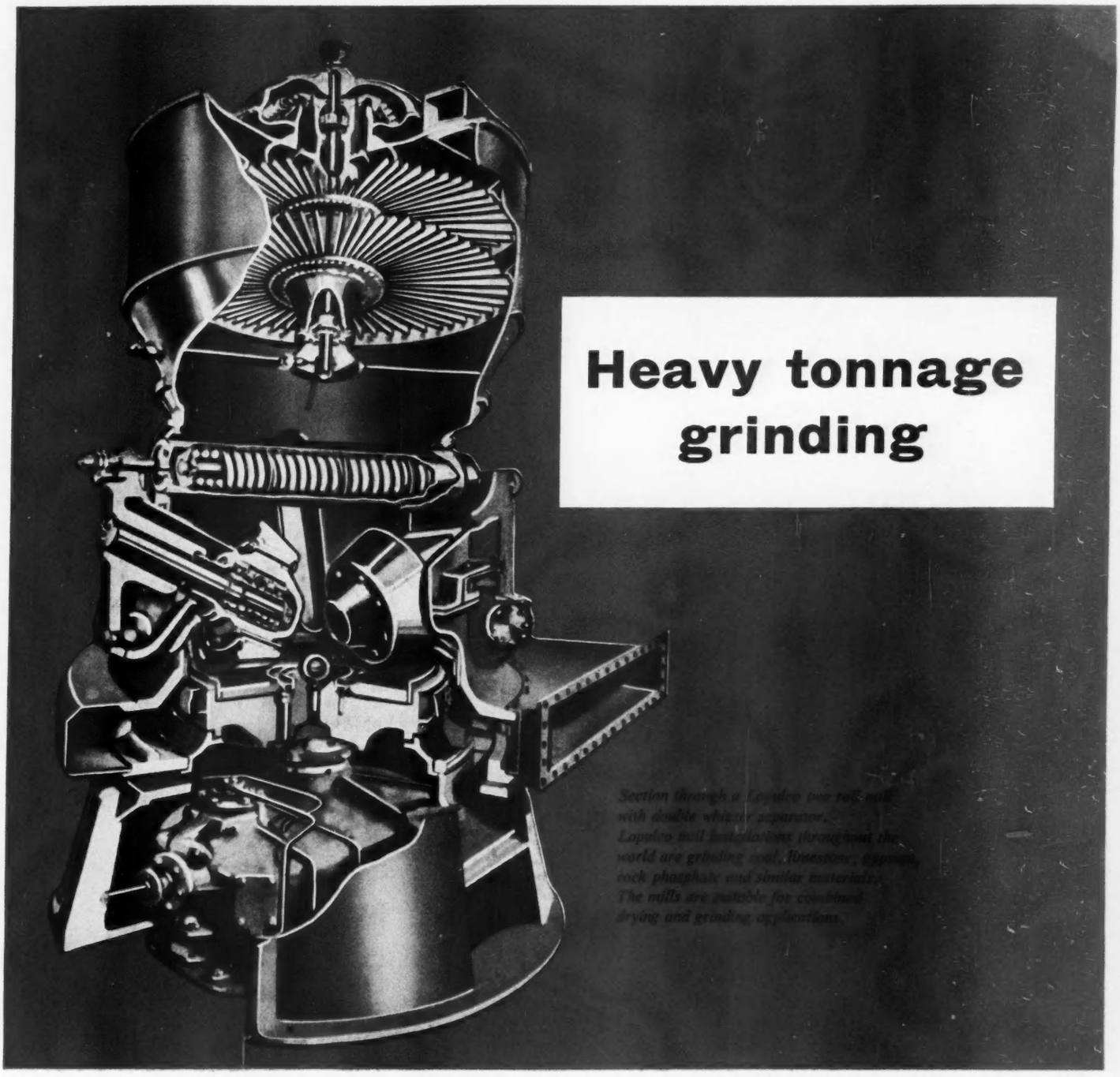
is the only company in Europe to devote its activities exclusively to the production and development of stainless and heat-resisting steels.



Heavy tonnage grinding

Section through a Lopulco two roll mill with double whizzer separator. Lopulco mill installations throughout the world are grinding coal, limestone, gypsum, rock phosphate and similar materials. The mills are suitable for combined drying and grinding applications.

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Efficient, dustless grinding at all load conditions with no actual metal to metal contact. High capacity with small space requirements. Power consumption is extremely low and very little maintenance is required.

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standards!

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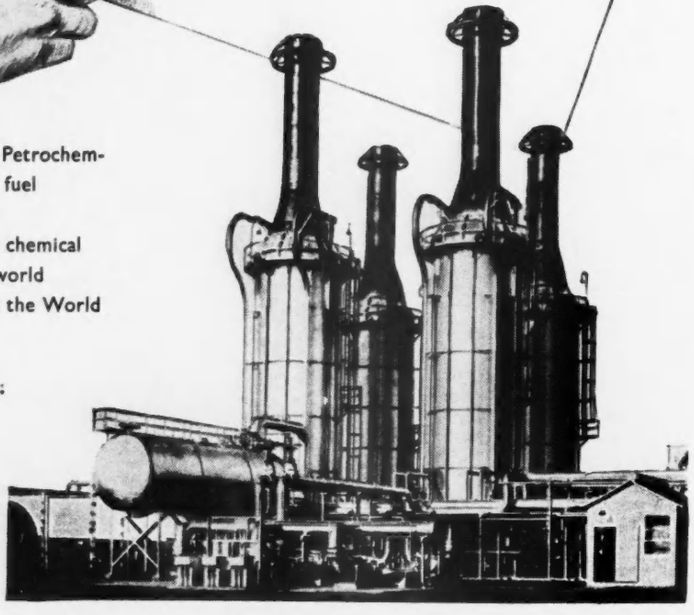

Many important design features place Petrochem-Isoflow first for thermal performance, fuel economy and low maintenance cost. Over 2,500 installations in petroleum, chemical and industrial plants throughout the world have established Petrochem-Isoflow as the World Standard of furnace efficiency.

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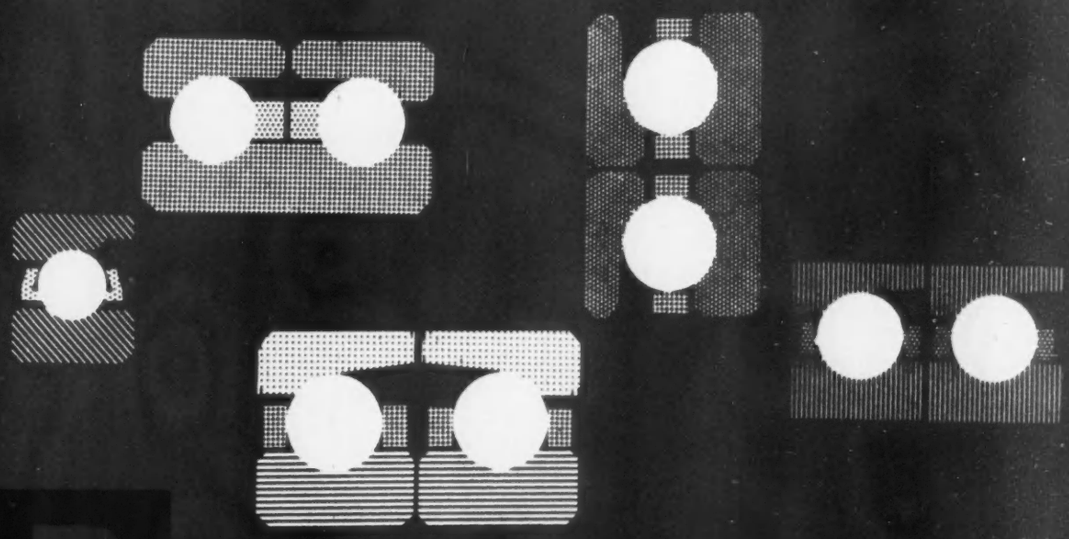

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one of the basic types from a range of ball and parallel roller bearings designed to meet every speed, load and application.

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- Can be mounted so that all play is removed from an assembly.
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- Can have a built-in preload or slackness to provide the exact assembly requirement.
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- The double Row series
  (a) provides a compact self-contained unit with the ability to carry heavy thrust and journal loads at high speeds.
  (b) has almost the same load capacity as two single row bearings — with the advantage of reduced space.

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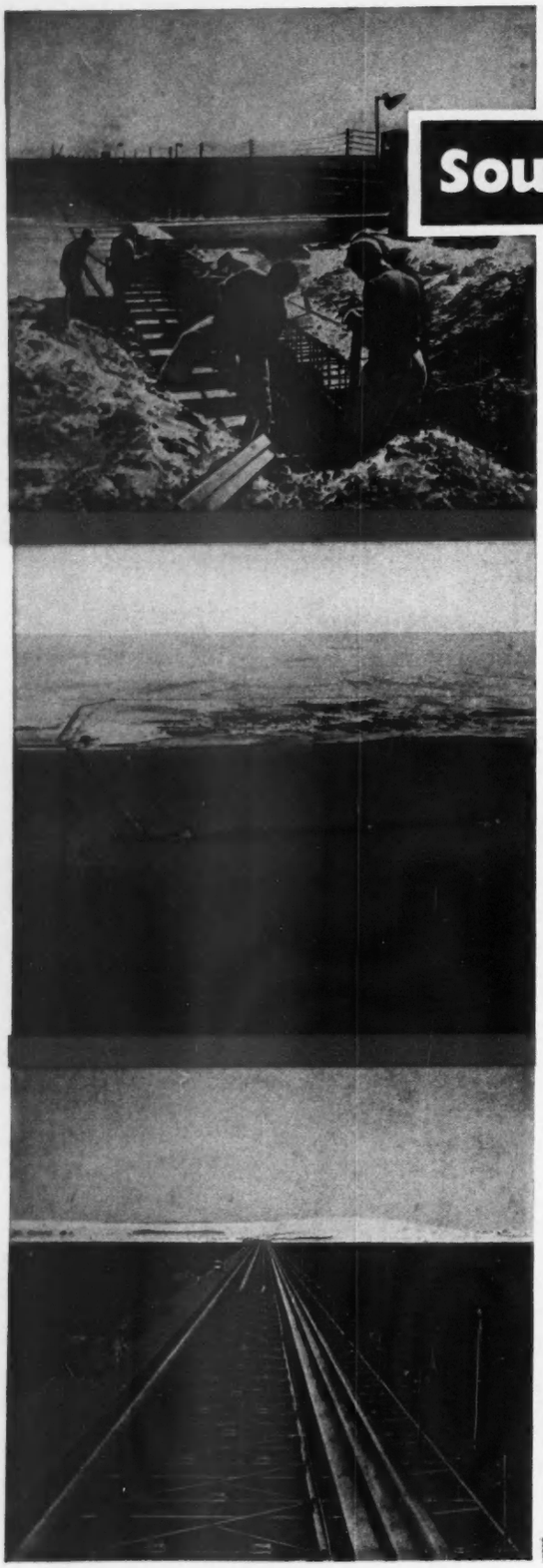

South Durham

at Mina al Ahmadi

For the construction of the Kuwait Oil Company's new North Pier at Mina al Ahmadi, Kuwait, and for extensions to its refinery, South Durham have been privileged to supply over 48,000 tons of steel made up as follows:

PIER PILES	**Tons**
"RENDHEX" FOUNDATION COLUMNS	**13,500**
PLAIN BROAD FLANGE BEAMS	**850**
TWIN BROAD FLANGE BEAMS	**2,030**
BROAD FLANGE BEAMS with plates welded to flanges	**2,640**
PIER DECKING	
BROAD FLANGE BEAMS (plain and plated)	**2,700**
EXTENSIONS TO REFINERY; NORTH PIER; TRANSIT AND GRAVITY LINES	
MILD STEEL PIPES from 18 inches to 40 inches diameter, automatically welded by the Submerged-Arc Process to A.P.I.5L Specification (approximately 100 miles)	**27,000**
Total tons	**48,720**

The pier is carried throughout its length on South Durham "Rendhex" Foundation Columns. Before shipment these columns were specially prepared at the South Durham Works where also all decking steelwork was prefabricated for welding on site. The total quantity of steel was shipped over a period of fifteen months. Another example of the way in which South Durham is "circling the globe with steel."

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USE-ROLLERS
Save Materials and Man-Hours

- ★ Quicker and more positive roller adjustment.
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- ★ Made in sizes 1½ in., 3 in. and 4 in.

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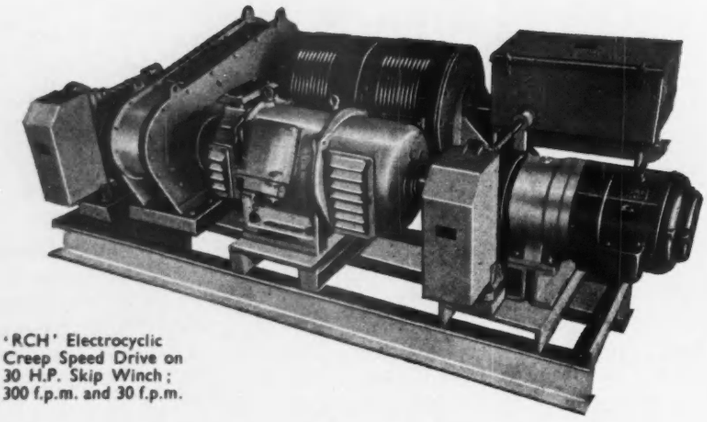
MAKERS OF THE WORLD'S GREATEST RANGE OF FORGING AND DROP FORGING PLANT

CREEP SPEED DRIVES *by* REED



'RCH' Electrocyclic Creep Speed Drive on 30 H.P. Skip Winch; 300 f.p.m. and 30 f.p.m.

Irrespective of load or direction the 'RCH' Electrocyclic Drive provides :—

- **Precise and constant creep speed**
- **Instantaneous speed change**
- **Heavy duty dynamic braking**
- **Inherent mechanical overload protection for 'Dead Stop' positioning**

A working model is available for demonstration.

E.O.T. Cranes up to 50 tons S.W.L. and 100ft. span Electric Hoists up to 15 tons S.W.L., Jib Cranes, Winches, Goliath Cranes, Telphers and Runways

Full Catalogue sent on request :—

Reed Crane and Hoist Company Limited

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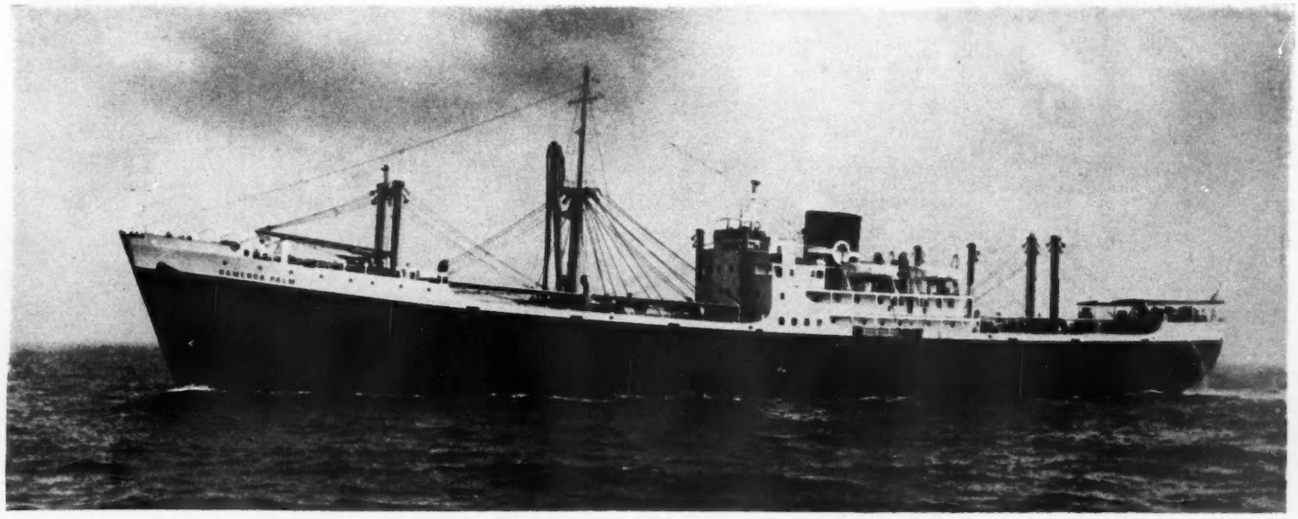

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APPLEBY FRODINGHAM

STEEL COMPANY

A Branch of The United Steel Companies Limited

SCUNTHORPE · LINCOLNSHIRE

THE UNITED STEEL COMPANIES LTD

(Top) M.S. BAMENDA PALM, 7,350 tons deadweight, length - 415 ft., breadth moulded - 58 ft., depth moulded to shelter deck - 35 ft., machinery -4 cylinder Swan Hunter Doxford 4,500 b.h.p. engine, hull built from substantial quantities of Appleby-Frodingham plates and sections. (Owners : Palm Line Limited, London. Builders : Swan, Hunter and Wigham Richardson Ltd.)

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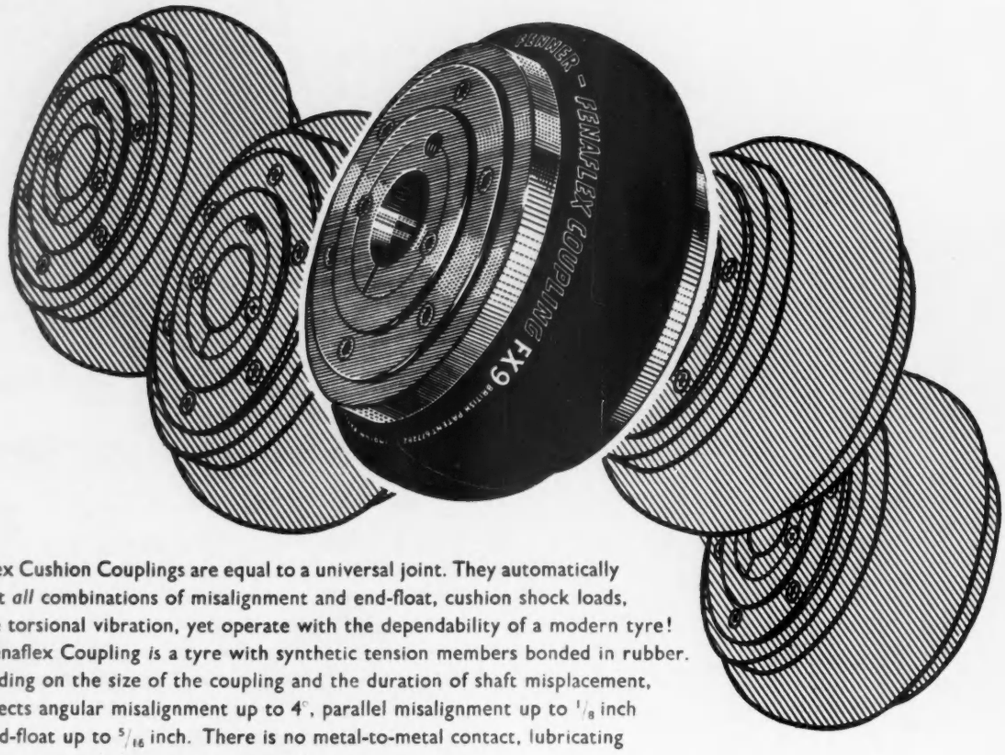
CUSHION COUPLINGS

THE RUBBER TYRE COUPLINGS WITH THE FOUR-WAY FLEX

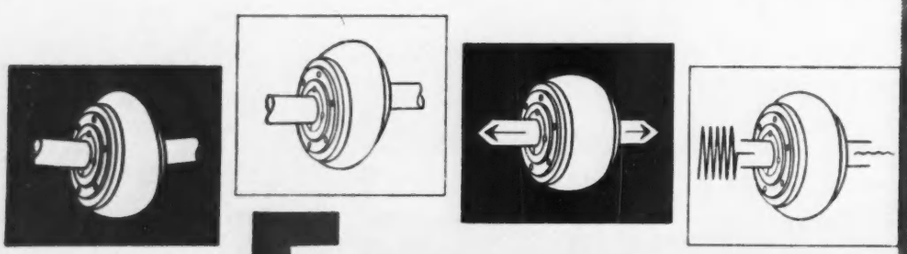


Fenaflex Cushion Couplings are equal to a universal joint. They automatically correct *all* combinations of misalignment and end-float, cushion shock loads, reduce torsional vibration, yet operate with the dependability of a modern tyre! The Fenaflex Coupling *is* a tyre with synthetic tension members bonded in rubber. Depending on the size of the coupling and the duration of shaft misplacement, it corrects angular misalignment up to 4°, parallel misalignment up to $^{1}/_{8}$ inch and end-float up to $^{5}/_{16}$ inch. There is no metal-to-metal contact, lubricating is unnecessary and there are no protruding parts.

This coupling occupies the minimum space on the shaft and Fenner standard Taper-Lock bushes make mounting quick and easy. As the flexible member is moulded with a transverse split, it can be replaced without moving the machine or the motor. This flexible coupling with time-saving TAPER-LOCK for fixing, is available in 9 sizes, the largest taking 20 h.p. per 100 r.p.m.

Leaflet 353/18 will give you full technical information.

SEND FOR IT **NOW!**



Fenaflex Couplings are obtainable from stock at all 19 Fenner branches and Fenner engineers will gladly demonstrate Fenaflex to you—telephone your nearest branch.

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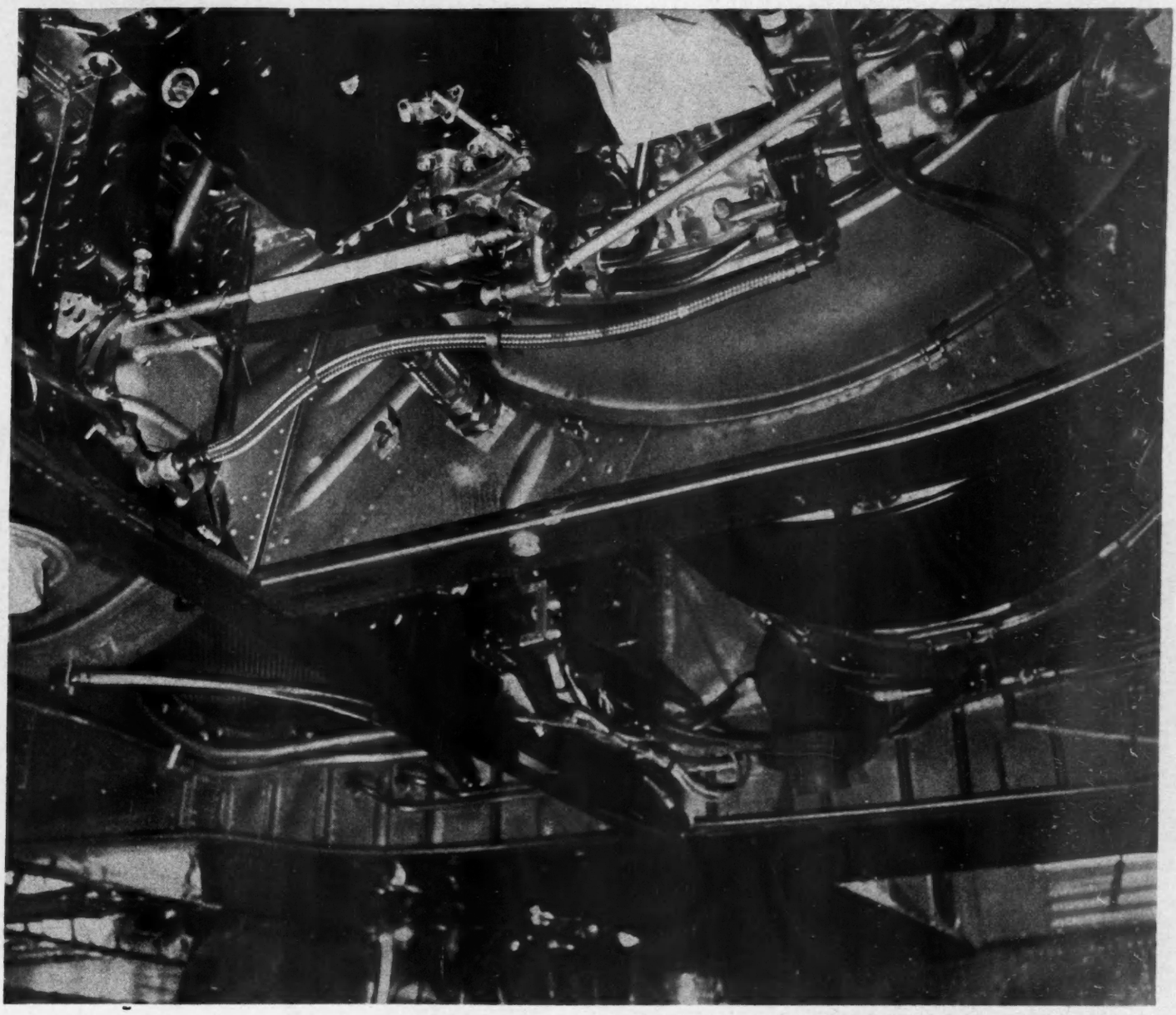
'FLUON' INCREASES PRODUCTION EFFICIENCY IN INDUSTRY



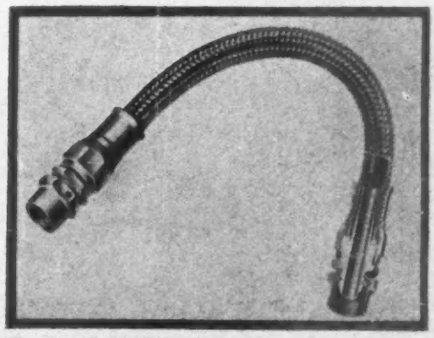
'Fluoroflex' Flexible Pipes lined with tubing made from 'Fluon' CD 1 in the de Havilland Comet

'Fluon' CD 1 is used in 'Fluoroflex' Pipes chosen for the Comet

As a flexible hose lining material 'Fluon' CD 1 is pre-eminent.

- Its flexural fatigue characteristics are exceptional.
- The only chemicals which attack it are molten alkali metals and a few fluorine compounds at high temperature and pressure.
- It can be used continuously at temperatures up to 250°C., and retains its tough, flexible nature down to at least liquid nitrogen temperatures.
- Its weathering characteristics are excellent and it has an indefinite shelf life.

These are among the many reasons why Palmer 'Fluoroflex' Flexible Pipes lined with tube made from 'Fluon' CD 1 are being fitted by The de Havilland Aircraft Company Limited to Comet aircraft. Tests carried out on these pipes correspond to 10,000 hr. life on the hydraulic system of the Comet 4 B.



'Fluoroflex' Flexible Pipe made by Palmer Aero Products Ltd., London, N.W.8, lined with tubing made from 'Fluon' CD 1 p.t.f.e.

'FLUON'

'Fluon' is the registered trade mark for the polytetrafluoroethylene manufactured by I.C.I.

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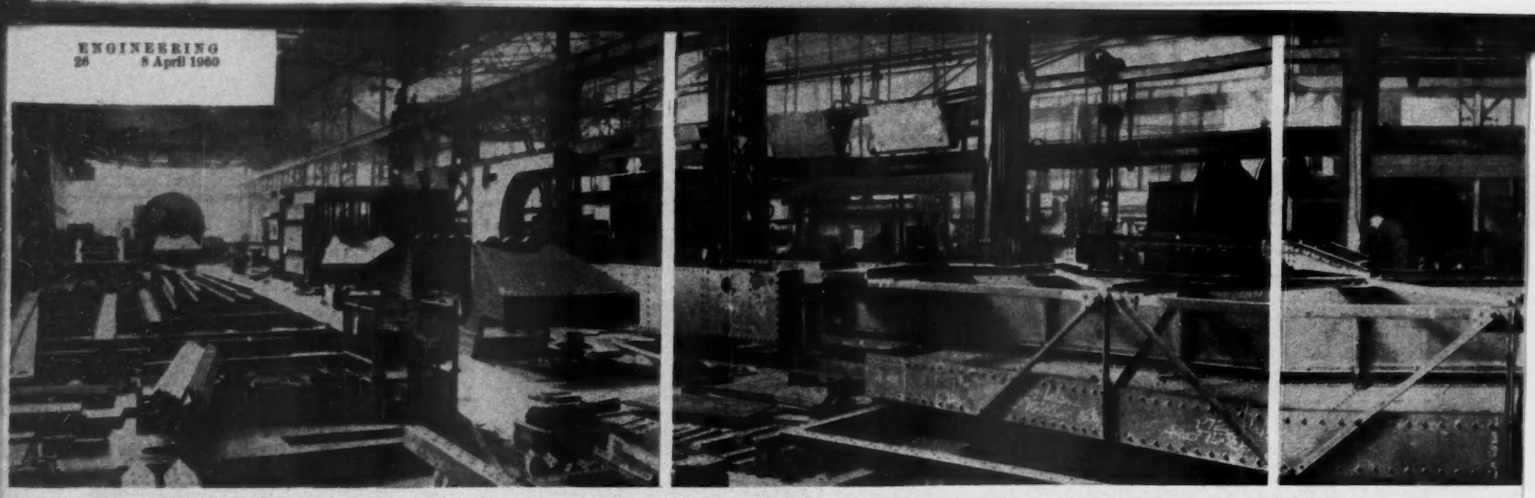

Panoramic view of the extended constructional shops

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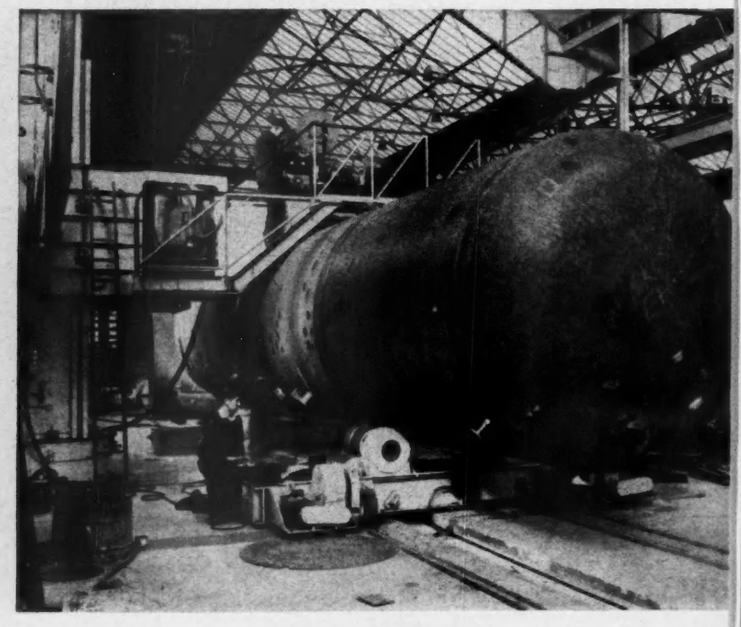
New production facilities

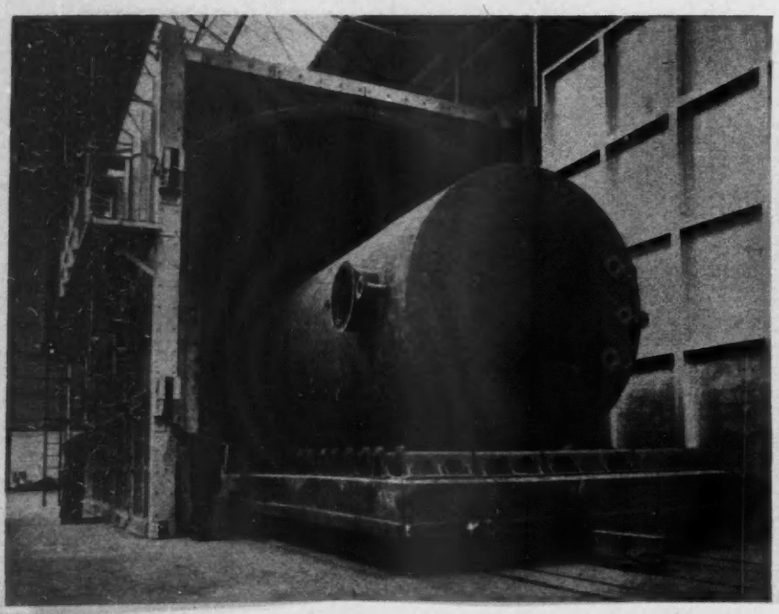
Preparing to cast in Meehanite metal in the foundries.

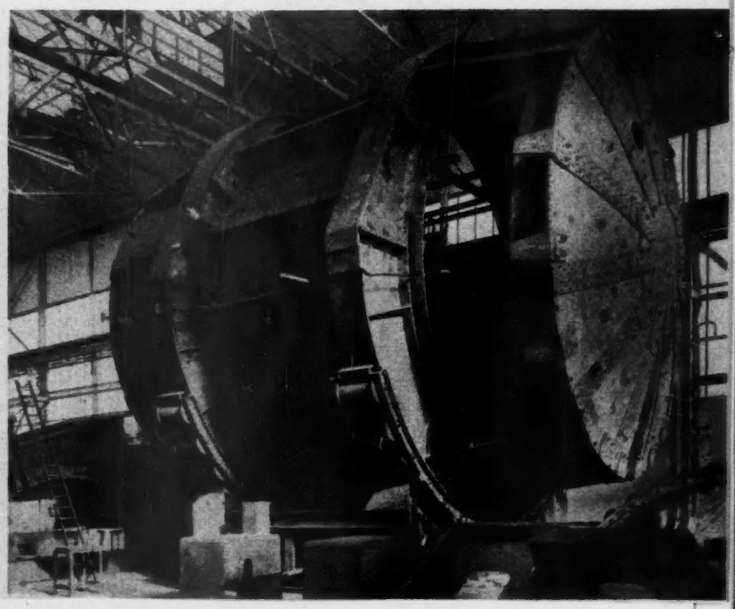


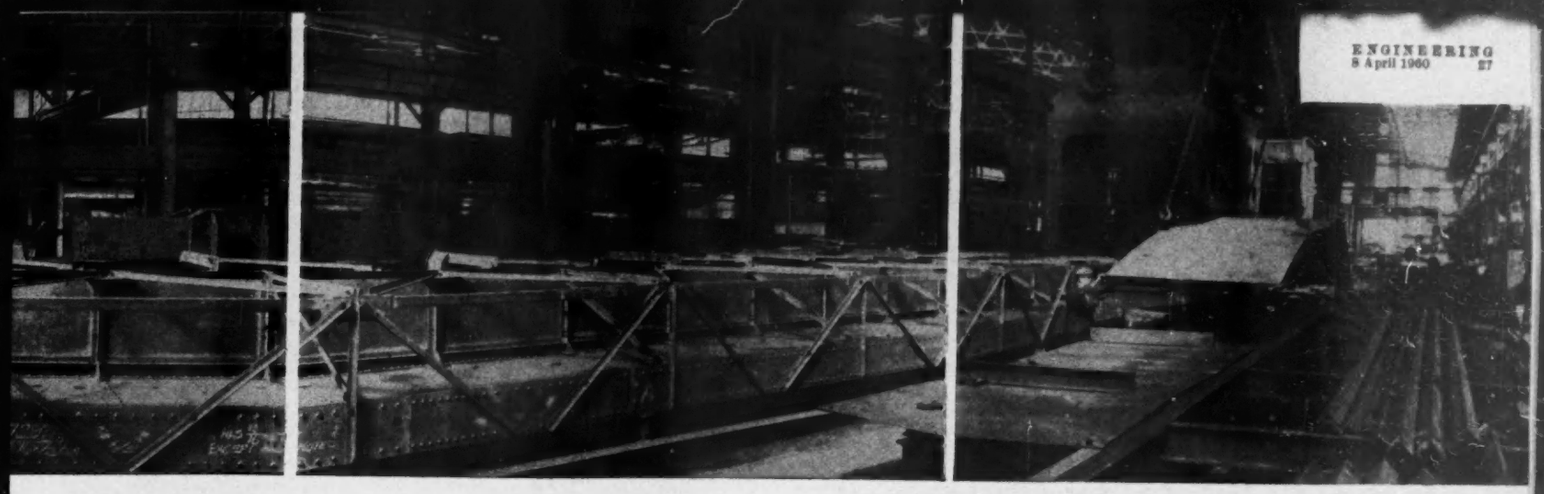
Automatic welding of a large pressure vessel.

The large new stress relieving furnace in use.

Hot metal mixer of 800-tons capacity under assembly.







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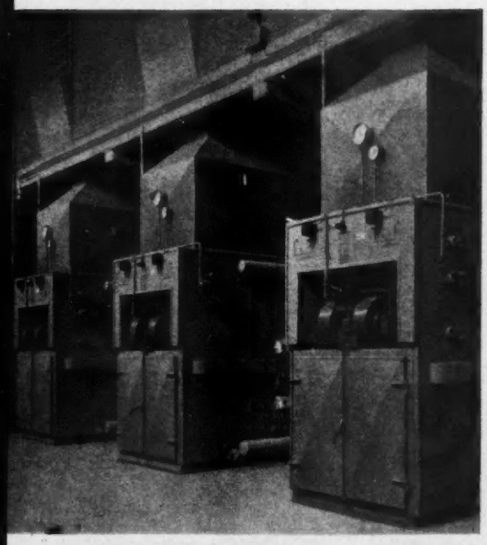
bring valuable new developments



Hydro Refining Pilot Plant at Thorncliffe.

MODERN FOUNDRY TECHNIQUES, including iron castings of all types and sizes in Meehanite metal.

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AUTOMATIC WELDING, x-ray examination and stress relieving.

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NEW TYPES OF HIGH PRESSURE GAS PURIFICATION and By-Product Plant, designed by Bischoff K.G., of Essen, to meet new gasmaking requirements.

COMPLETE CENTRAL HEATING SCHEMES based on the Redfyre "Emma" coke-fired boiler—the most efficient coke-fired boiler in the world.

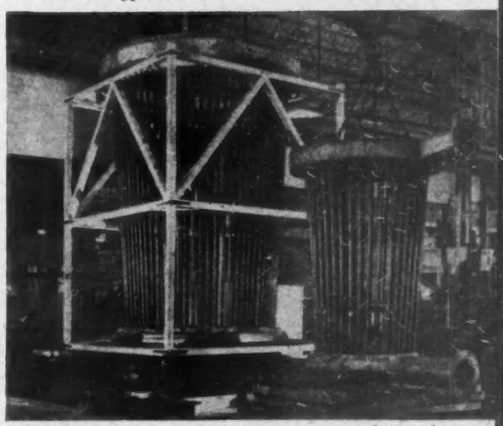
A Redfyre "Emma" Boiler installation.

Newton Chambers

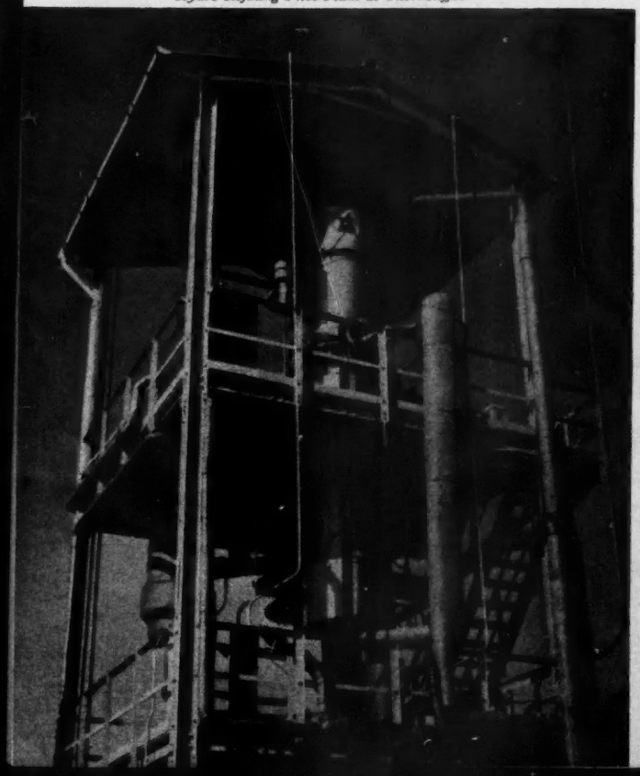
ENGINEERING DIVISION

NEWTON CHAMBERS AND COMPANY LIMITED
THORNCLIFFE · SHEFFIELD

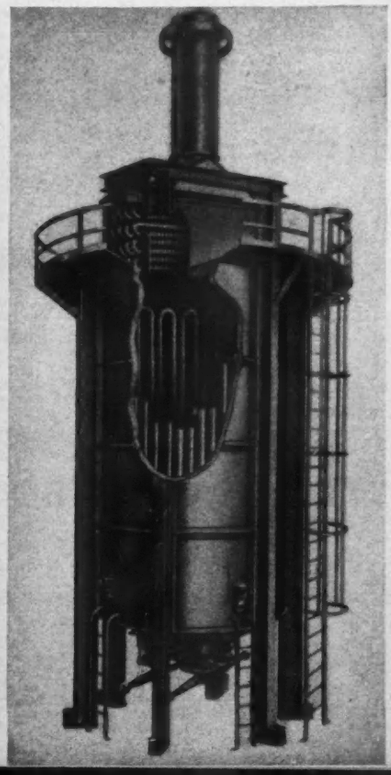
INKA Radiant type Preheater tube bundles under construction.

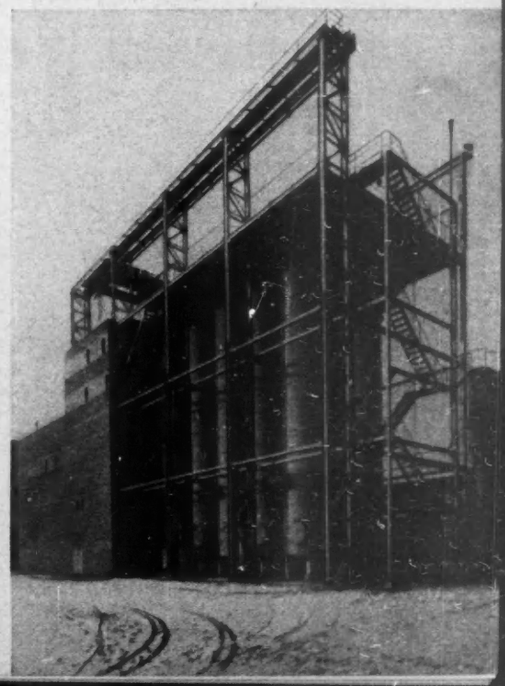


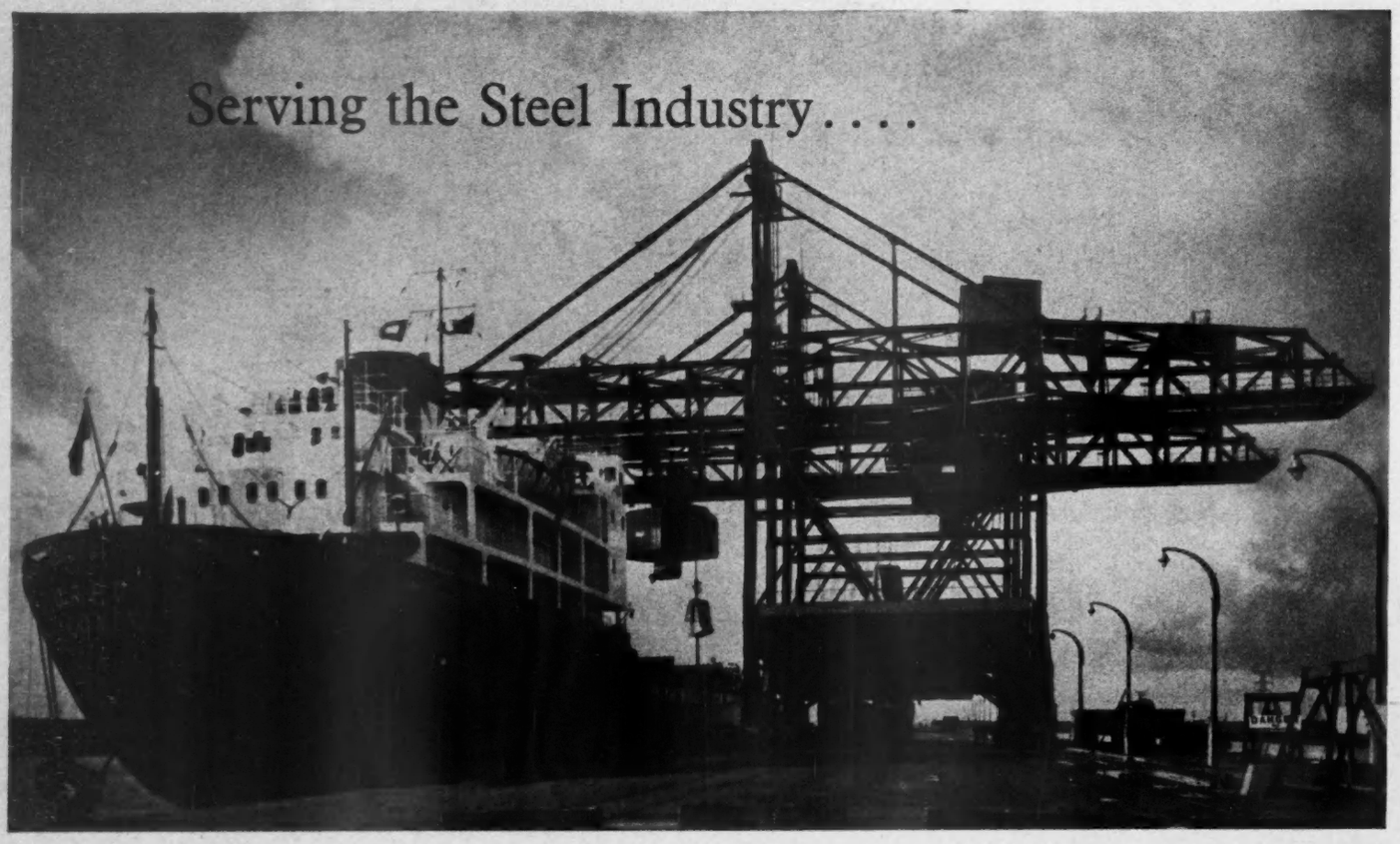
A typical Newton Chamber/Bischoff high pressure purification plant.



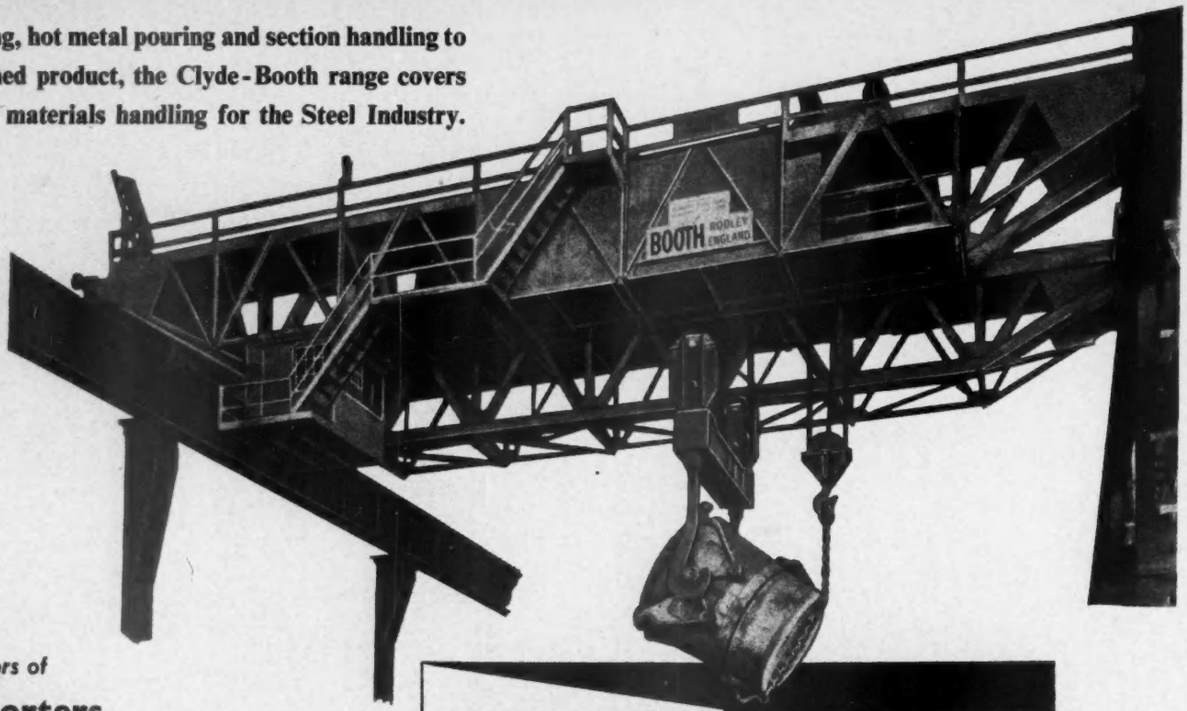
Struthers Wells direct-fired heaters.







From ore unloading, hot metal pouring and section handling to shipping the finished product, the Clyde-Booth range covers the field of heavy materials handling for the Steel Industry.



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CLYDE BOOTH

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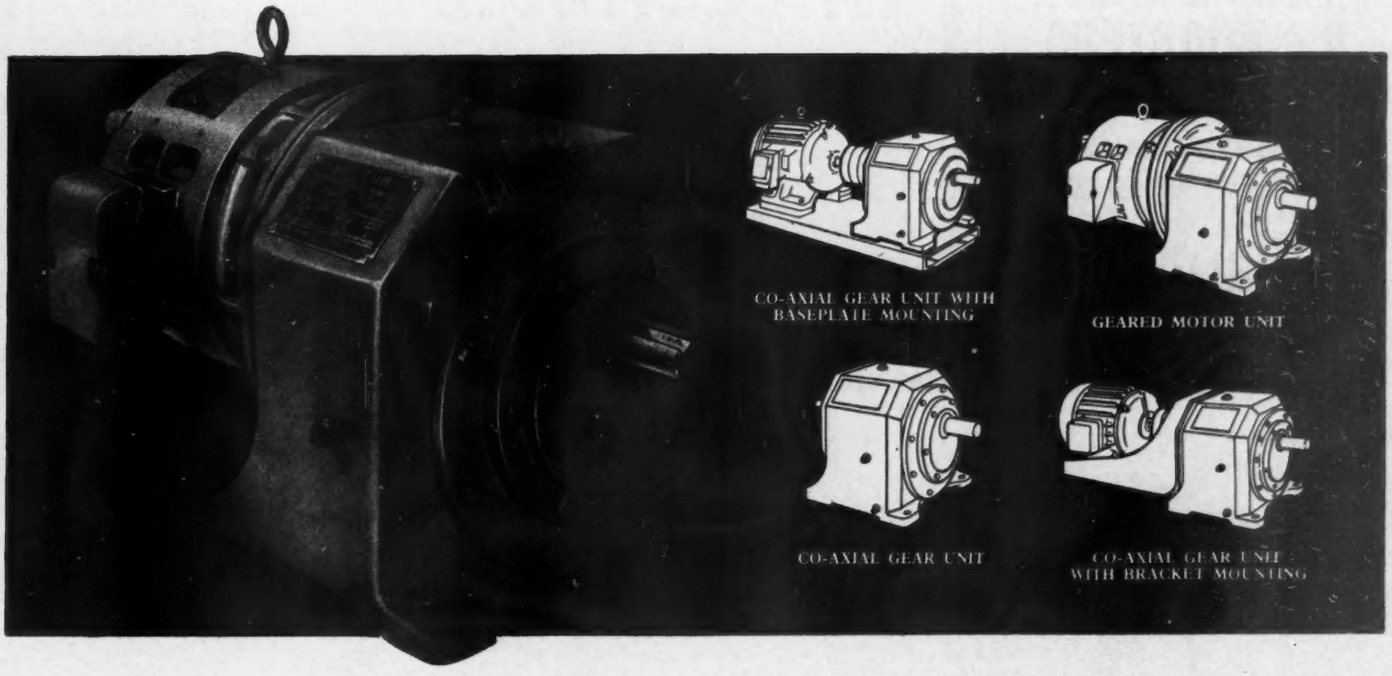
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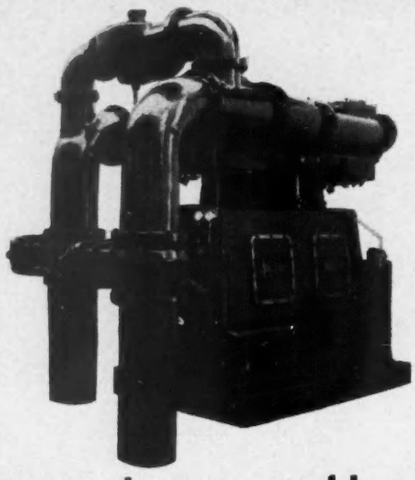
These Gas Compressors, capacity 400,000 cu. ft. per hour at 15 lb/sq. inch, are installed at Etruria, Stoke-on-Trent.

Photograph by courtesy of West Midlands Gas Board.



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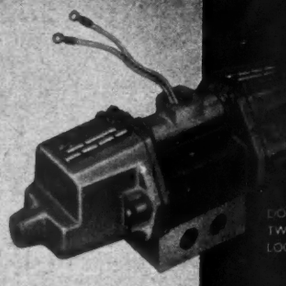

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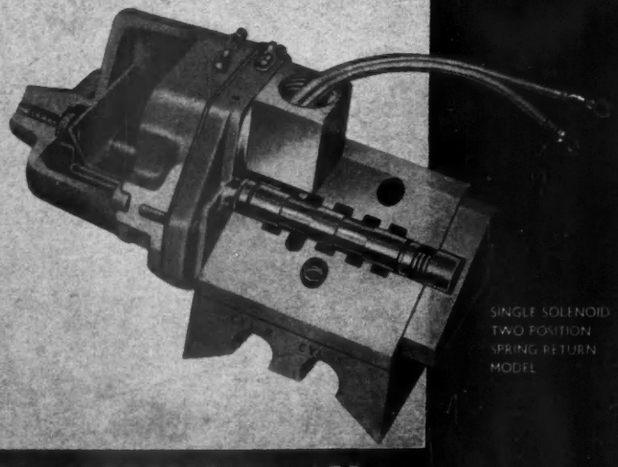

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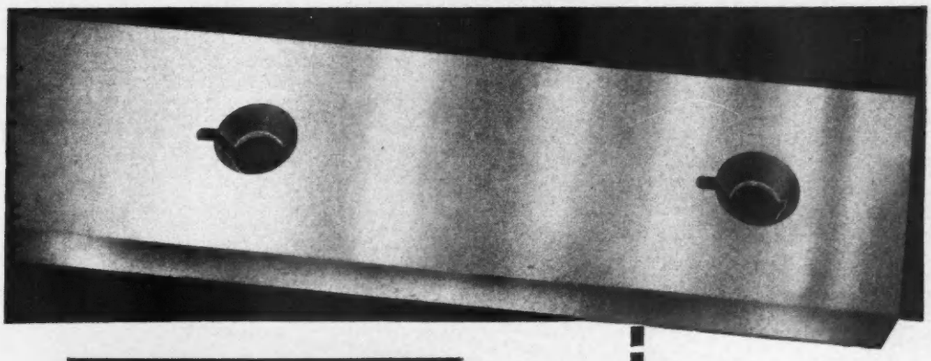

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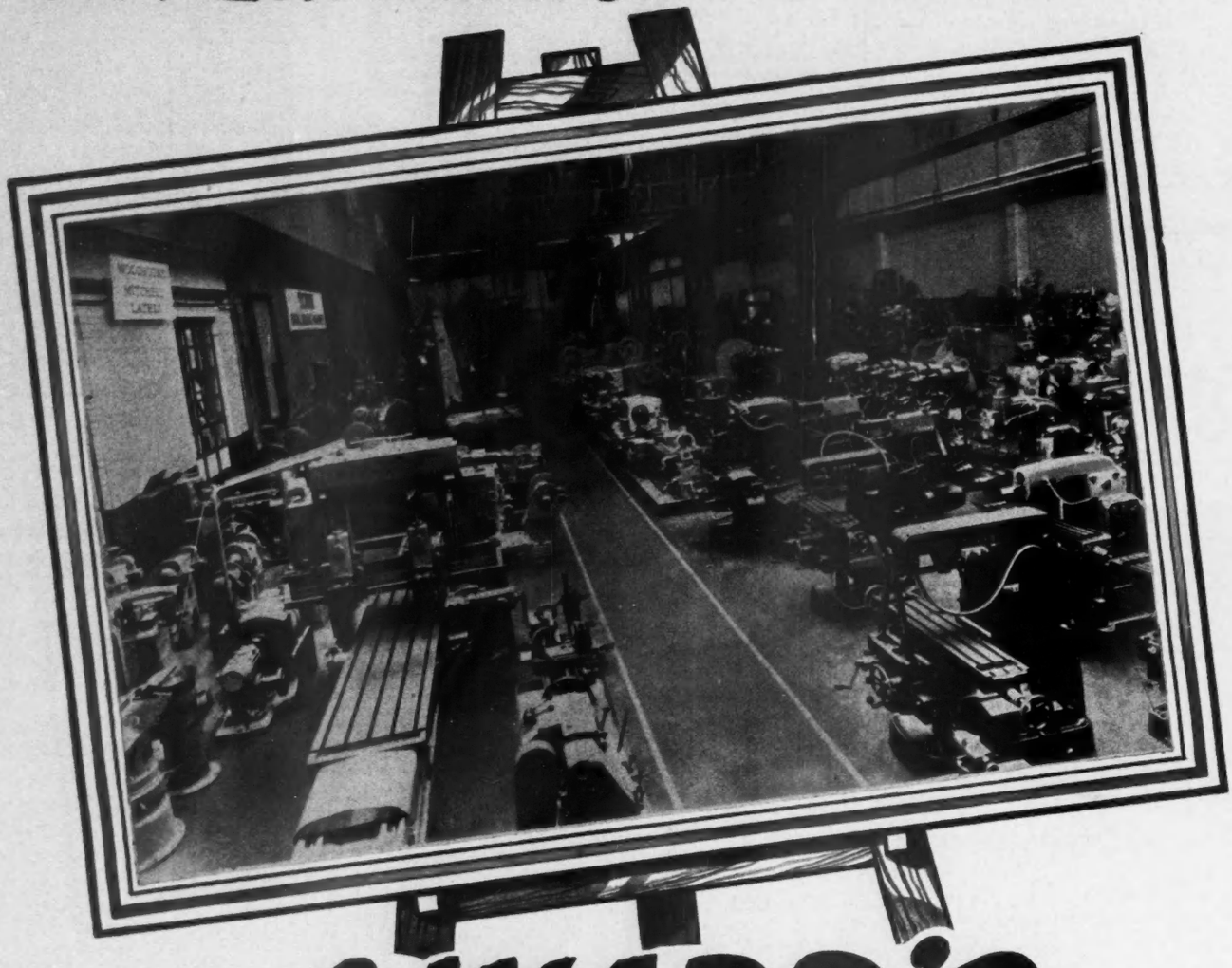

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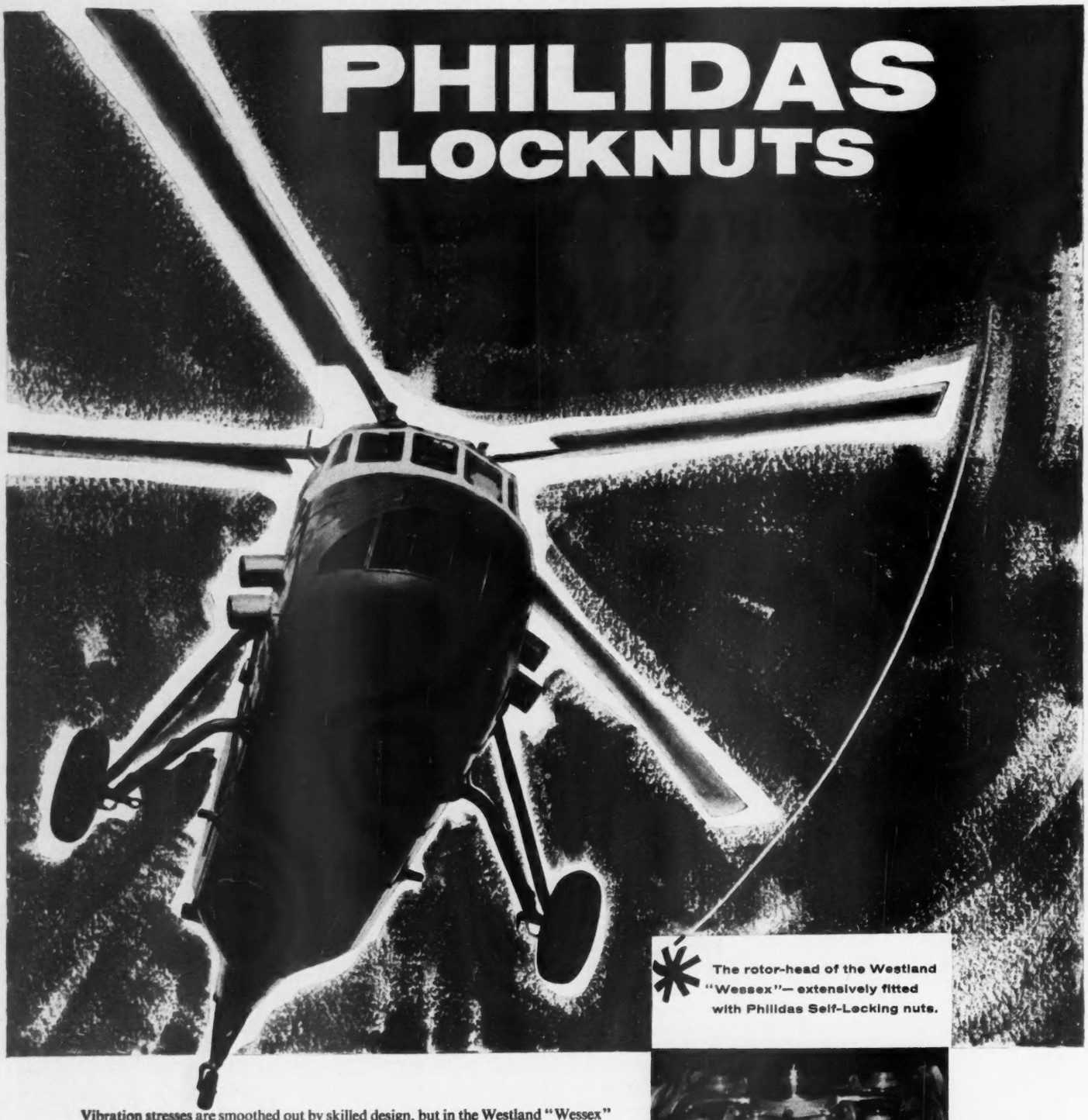

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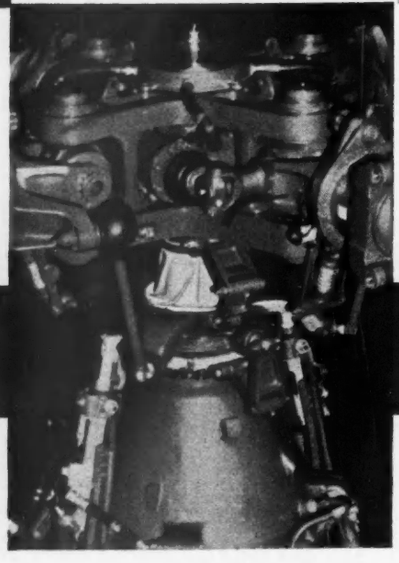

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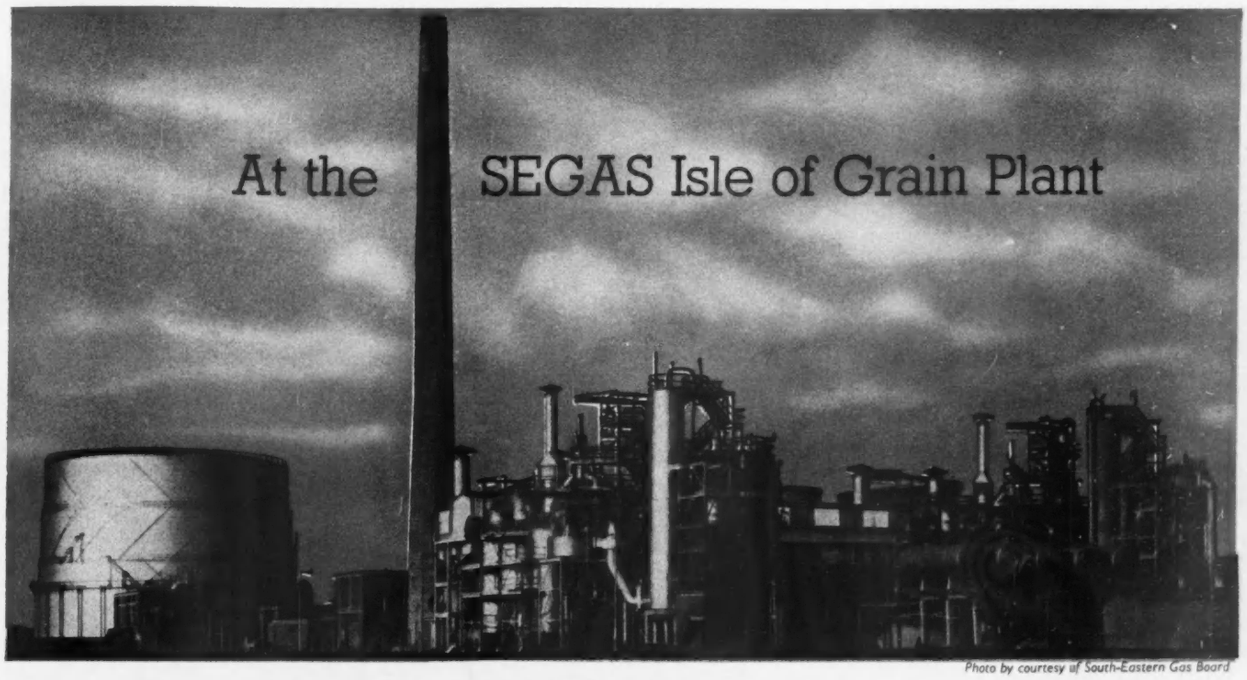
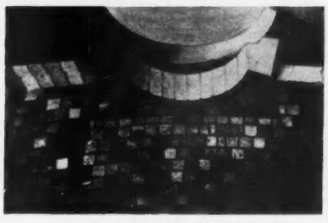


Photo by courtesy of South-Eastern Gas Board

R.B.HILTON installed the refractory linings



Access hole blocks

Gas from oil at the new Segas Isle of Grain plant is the latest development in British fuel production. A high standard of refractory brickwork is called for in the lining of these ducts and the installation of the arches and domes. Both workmanship and materials must be of the highest quality.

R. B. Hilton Limited carried out the work using materials supplied by General Refractories Ltd. A team of experienced craftsmen worked under the supervision of the Area Manager and the personal scrutiny of one of the company's directors.

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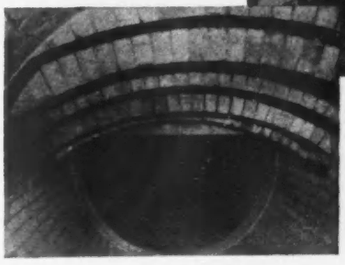
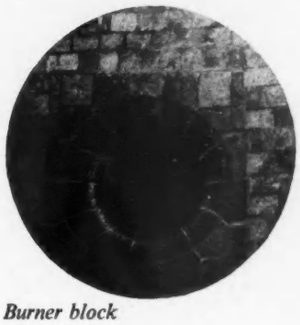


Stepped arches



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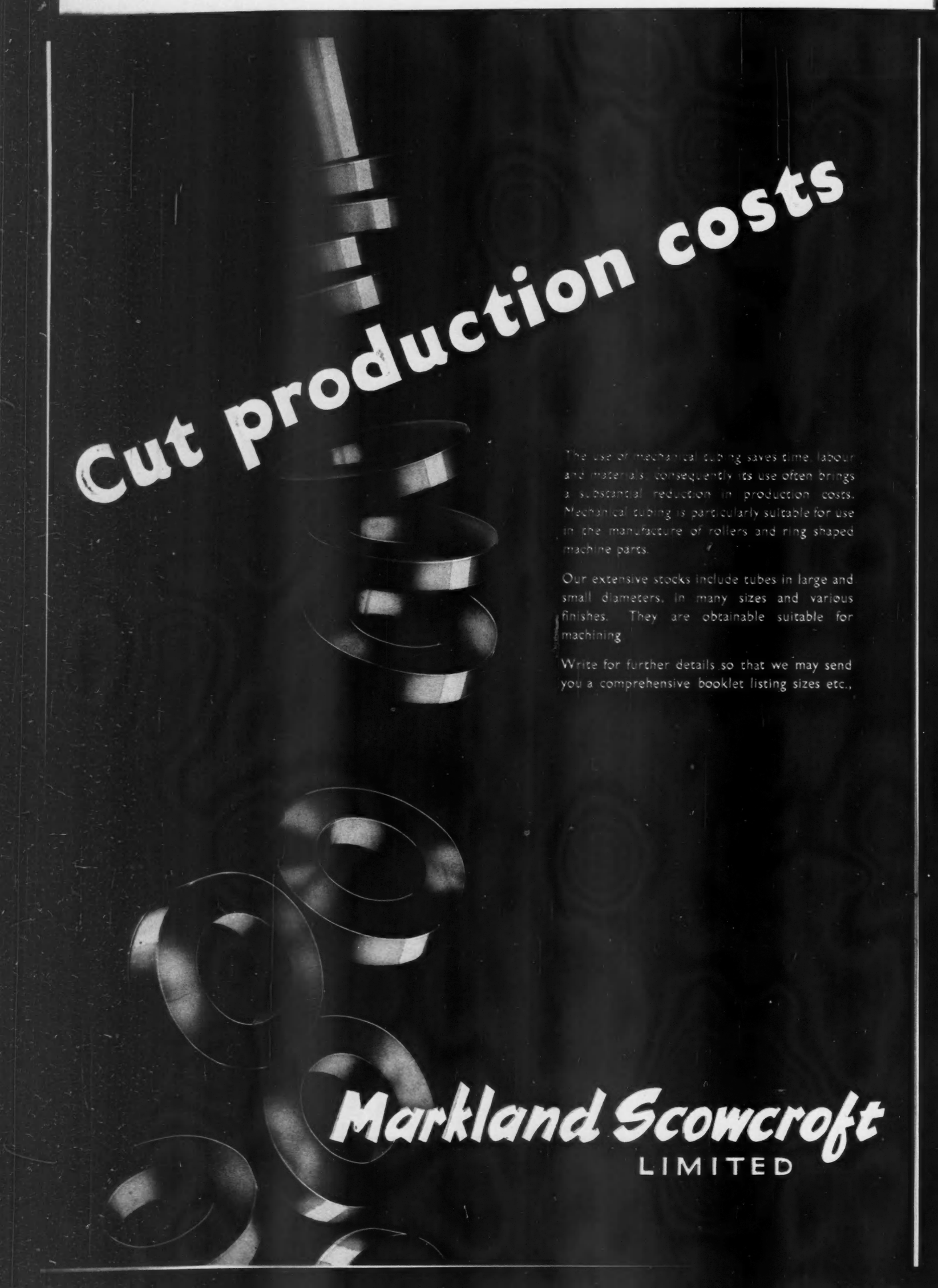
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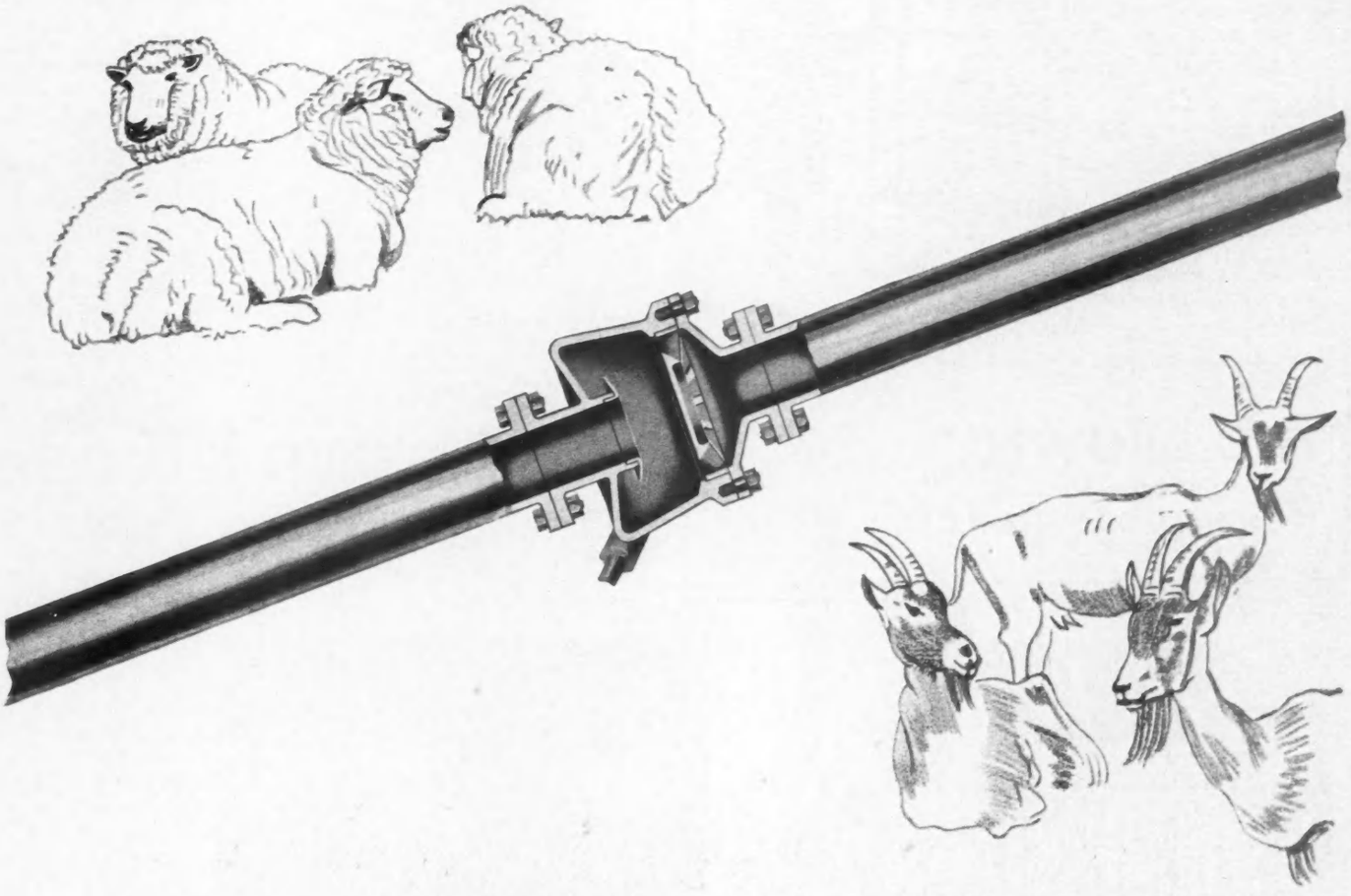
Oil and Water!
it's all a matter of separation



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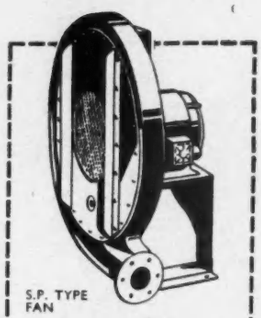

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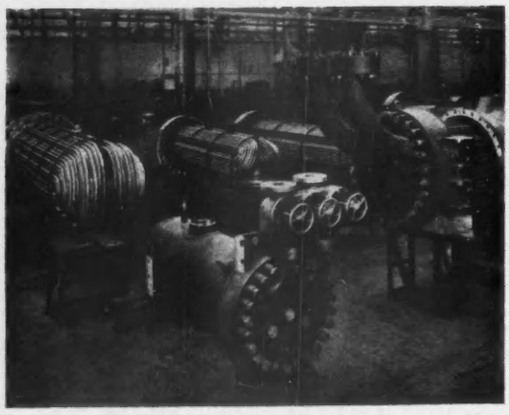
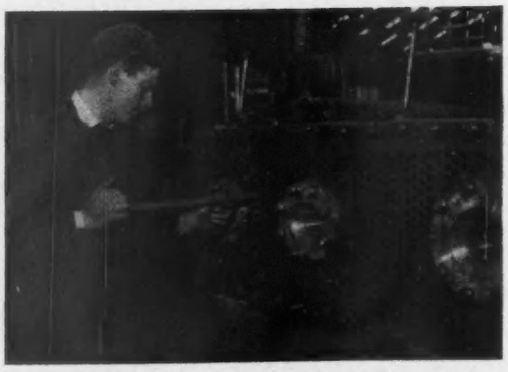
Tubes in 70/30 and 70/29/1 Brass, "Hudal" Aluminium Brass—Copper—High Speed Screwing Brass—Hungarian Alloy—Screwing and Bulging Quality Brass "6615" Alloy—Naval Brass—"Hudnic" 2·0 Cupro-Nickel.



H & W solid drawn copper tubes used in construction of Weir Marine Feed Water Heaters. (Photograph by courtesy of Messrs. G. & J. Weir Limited.)

used by the leading shipbuilders and engineers



Fitting "Hudal" aluminium brass tubes in Weir Three-stage Air Ejector for the liner "Reina del Mar". (Photograph by courtesy of Messrs. G. & J. Weir Limited.)

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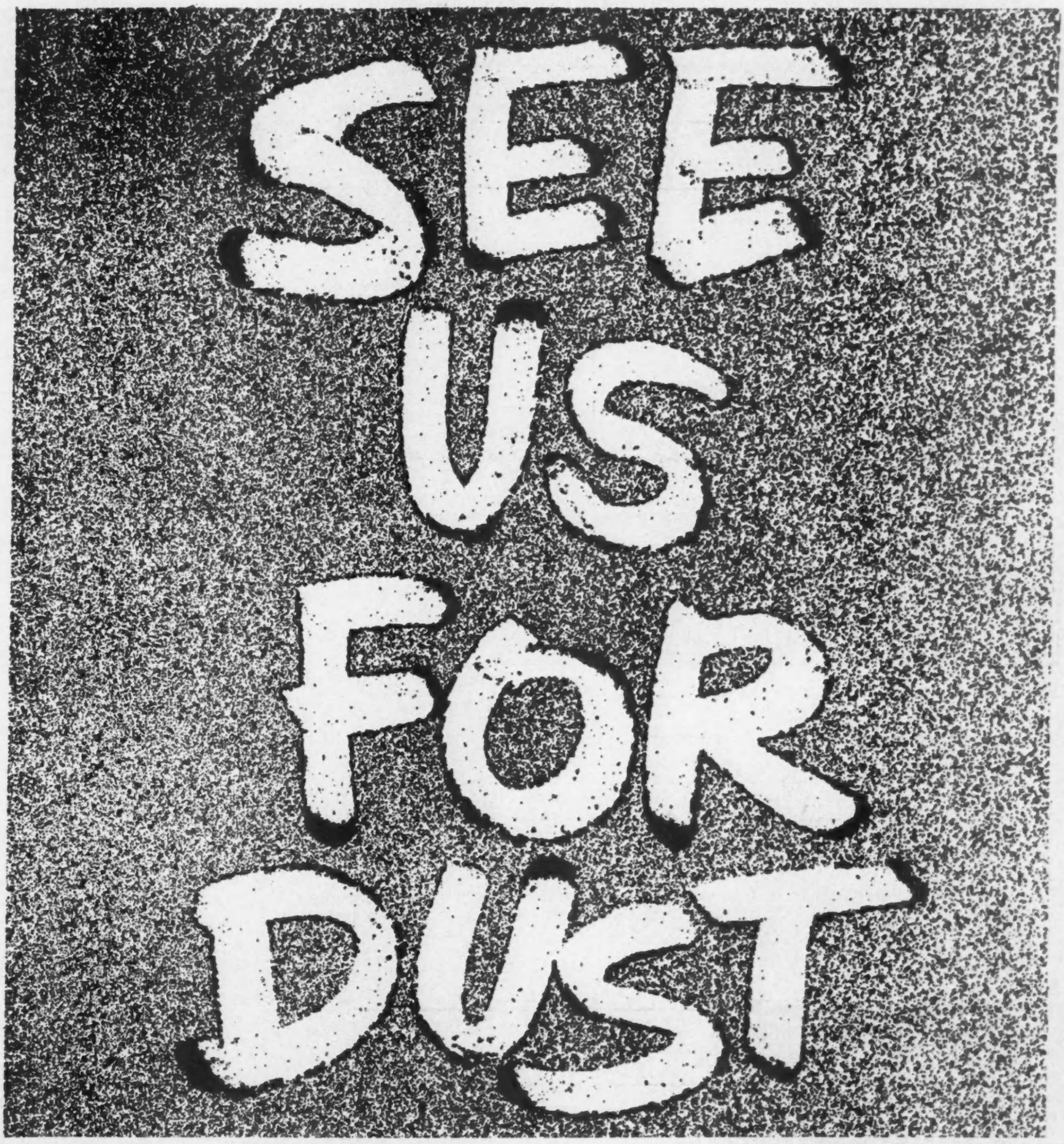

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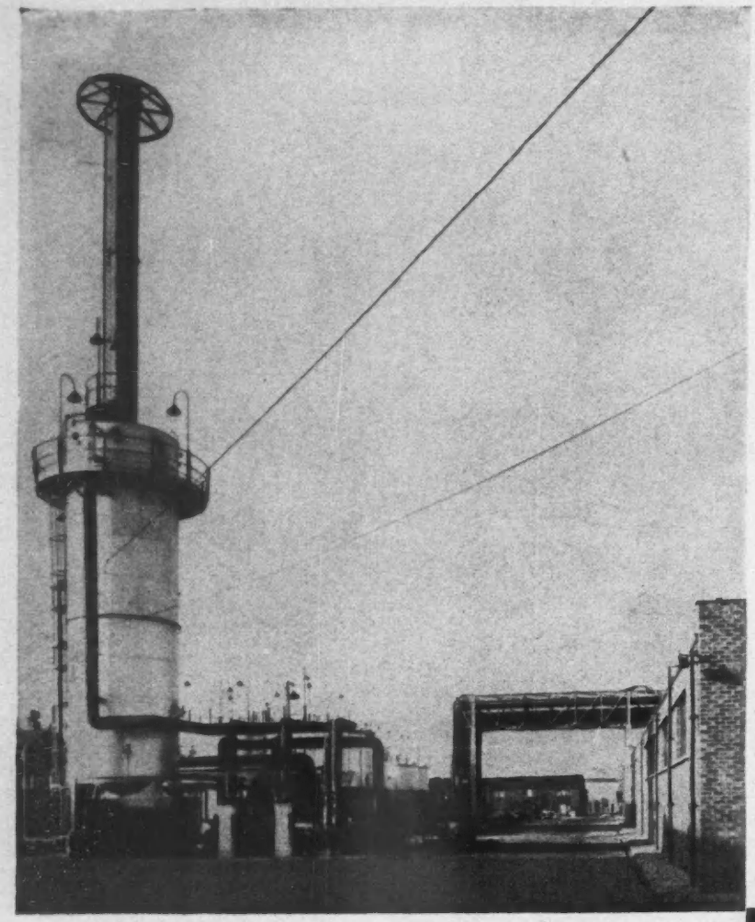

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TUBESTILLS Head Wrightson Processes offer Tubestill equipment to cover all requirements of the oil and chemical industries. It can be individually designed for each application. Efficient convection sections are fitted when desirable, and particular attention is given to equal heat distribution in the radiant zone.

Available for duties from 300,000 to 30,000,000 B.T.U's per hour these furnaces have the following advantages:

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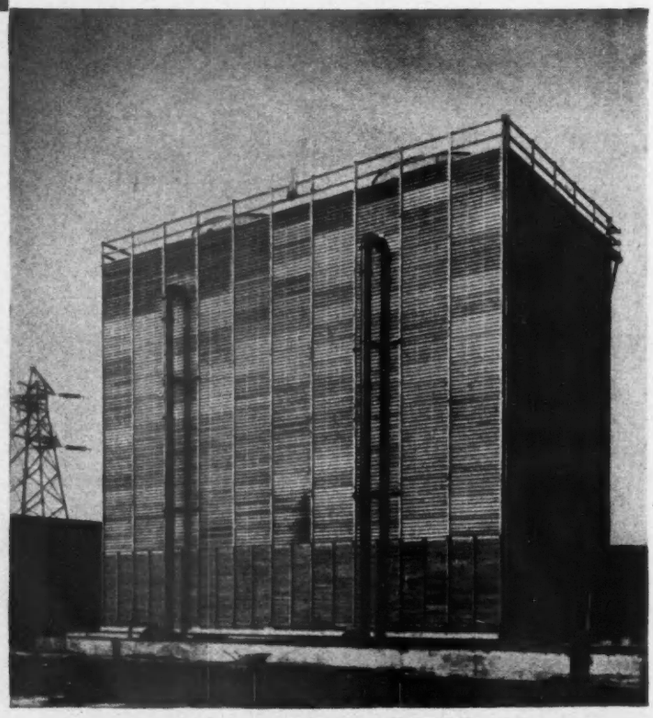
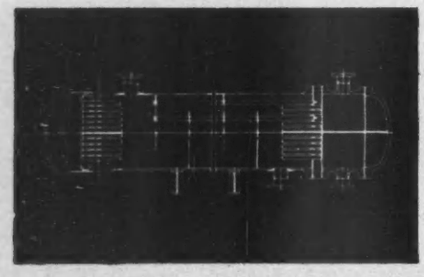
Please write for details of a recent development in the design of a concrete tower in which all the main units are constructed of factory controlled precast concrete.



HEAT EXCHANGERS



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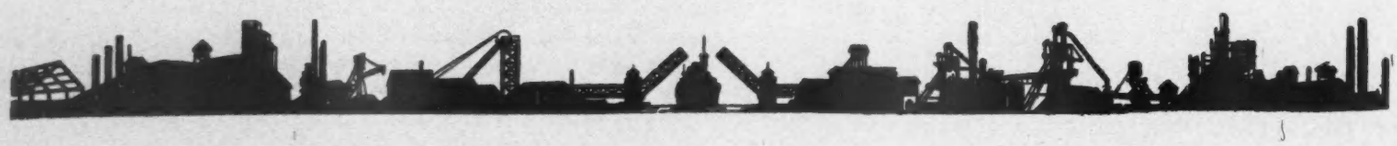
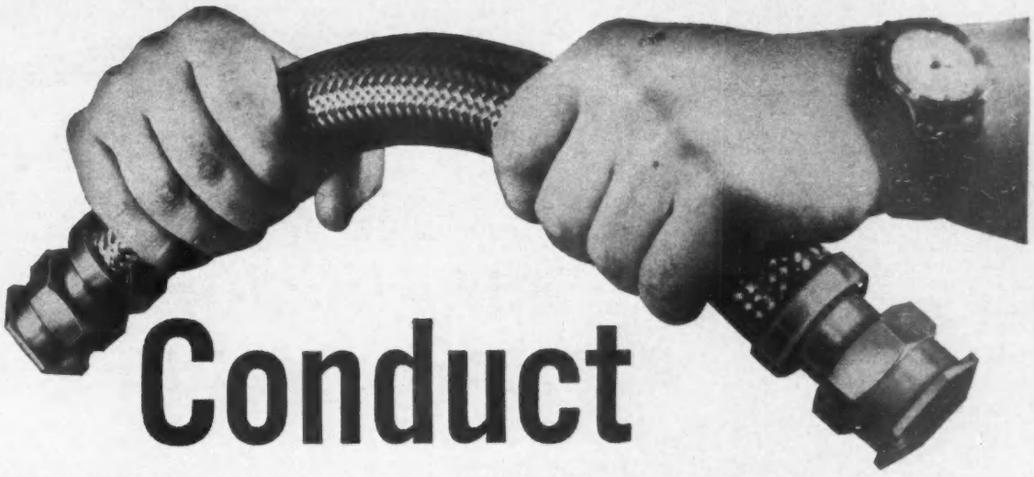


Safe Conduct



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ENGINEERING Impact

of a Budget without Shocks

The smooth and successful control of a machine is not usually spectacular. But it is the best course for the controller and for the machine.

And this is essentially what Mr. Heathcoat Amory's no-change Budget of this week was. The Chancellor used the phrase "a touch of the brake." But 2½ per cent on profits tax and some curbing of tax evasion will not perceptibly slow down the wheels.

After the economic see-saw of the post-war years this Budget is a vote of confidence in the ability of the United Kingdom's industry to go on raising the prosperity of the country without bringing on another crisis. Instead of taxes being flashed on and off like traffic lights, red for deflation, green for reflation, the pattern has been held as it was and industry is able to go on with its planned expansion. Damaging alterations in the conditions governing its home markets have been avoided. Mr. Heathcoat Amory has not been panicked by the imports of sheet steel into disregarding the Radcliffe report and tightening up hire purchase or raising the purchase tax on motor cars and household equipment. He has contented himself with a warning of his readiness to curb expansion of credit.

Have the wild swings in the economy been tamed?

Nothing is worse for a system than the disconcerting phenomenon of hunting, plunging swiftly from overload to loss of power to the bewilderment of its controllers and to damage or destruction. This can happen in the economic system. The 1929 collapse in the United States was the supreme example.

Since the war the British problem has been, while keeping full employment, to earn enough abroad to pay for all the imports demanded by the fully employed. The Budget gives industry the chance to expand unimpeded, and perhaps to improve the ratio of exports to imports.

But there is no shortage of serious challenges. The wind of competition blows even colder. The European Common Market, as well as preferring to trade within itself, may develop great exporting strength based on its huge home market.

And when we have met these there are the emerging nations overseas. If they are not to be lost to our wider cause we have to conduct our economy so as to find more aid for their development.

Superliner Doubts

Purely technical considerations have always been subject to commercial approval in engineering—as, indeed, they should be. The question of replacing the Queen Mary and the Queen Elizabeth for the transatlantic traffic is a good illustration of this fact of life. So riddled with subsidies and loans is the economy today—railways and airlines, as well as shipping—that the major questions of capital investment are often unanswerable in precise terms.

The engineering impact of the decision to build or not to build replacements for the Queens is profoundly important but also incalculable. The Chandos Committee must gauge the effect on British shipping and shipbuilding of a decision either way.

The present Queens attract traffic not only to themselves but also to British shipping generally—and perhaps even to British airlines. But there is a formidable list of objections to building two superliners at about the same time. As they have a life of about 25 years, this is too long to wait before it is possible to incorporate the latest technical developments in, say, propulsion methods.

Three, or even four, smaller ships to replace the Queens would, if built over a long period, meet this objection, and would be better for shipbuilders than two mammoth orders within a few years of each other.

The Government are faced with an extremely difficult decision, however clear-cut is the Chandos report.

Yesterday and Tomorrow

Normally, the eyes of engineers are focused on the future; it is their business to run ahead of time. But occasionally they may profit by looking back. To paraphrase the jurist Maitland: we study yesterday so that today may not paralyse tomorrow.

Among the brewers and distillers, the publishers and apothecaries whose records were on display at the Exhibition of Business Archives in London could be seen the features of several engineers and the companies they served or founded. Visitors to the National Book League where the exhibition was held were able to see, for example, metallic specimens used by Robert Foster Mushet (1772-1847) in the development of tungsten steel.

But if as engineers we set our attention too fixedly upon the future, we may suffer the same fate as one, Archias, who, during the occupation of Thebes by Sparta, received while dining a note warning him of his impending murder. With a cry of "Business tomorrow" he put the note aside.

Tomorrow never came.

The Common Market and the United Kingdom

In the space of a few significant years the United States has been developed into the leading overseas market for British exports. But across the Channel Europe is growing in industrial activity at a rate five times higher than the American development of recent years.

Leading the surge of European progress is Western Germany, which by the prosperity of its people and the pace of its changes in production could be a very important future market for United Kingdom firms. Export markets further across the globe carry for their long term prospects the reservation that as local industry becomes able to compete, the cost of carrying our products to the distant market will become a more serious handicap.

These are among the facts that give rise in this country to so much anxiety at the determination of Professor Halstein, the president of the European Commission, to rush forward into further integration of the six members of the European Common Market.

Whether the division between the two trading groups can be prevented from spreading to the defence field is a question on which an optimistic answer can only be given in defiance of such obvious considerations as the importance of defence contracts and the social as well as strategic importance of maintaining shipbuilding dockyard facilities.

The outlook is not all black, even if the United Kingdom's arguments against a European economic split are met only with futuristic speculations on a North Atlantic trading community. Equalising the European Common Market members' tariffs may raise some walls, but it will lower them on some manufactured imports at France and Italy.

of Ventilation or Paint across the Channel

If you liked the prospect of a Channel Tunnel you will be pleased at the suggestion of the bridge from South Foreland to Sangette. For roughly twice the outlay—£200 million instead of £100 million—the bridge will do substantially more to convey tourists and commercial travellers, consumer goods and heavy industrial products between Britain and the Continent. If the prospect of closer contact was repugnant, then the extra £100 million will be even more distasteful, though you will probably console yourself with the reflection that neither venture is likely to mature in the immediate future.

For the industries that might be involved in the construction of either of them the choice between the bridge and the tunnel could change the shape, and certainly the thickness, of the order book. For the steel industry the bridge is much the better prospect—to the tune of 800,000 tons of structural steel. There is not so much in it for the concrete people, they either do 142 massive precast piers or line 60 miles of tunnel, though the cement industry will prefer the latter. The ventilating industry, however, get nothing out of the bridge but their biggest task ever in the tunnel.

The paint industry, too, face the same possibility, though in reverse, for in the gusty spray-laden atmosphere of the Channel the bridge will require a regular repainting that will make the old Forth Bridge contract small by comparison. The illumination people will do slightly better on the bridge if only because of navigation lights, though the result could also be a magnificent spectacle at night. The civil engineering contractors, leaving aside the steel people, probably favour the tunnel. Their contract for the tunnel will be bigger than for the bridge—and will not have to be shared among so many.

And the consultants? They could win either way.

Rising Losses from Major Fires

Nineteen deaths in the sudden disastrous development of a Glasgow fire underline in human terms what in financial terms has been a rapidly and seriously rising bill for fire losses.

The increasing number of factories and other buildings in existence and the greater amount of work being done in them could, fatalistically, be expected to give rise to more fires. But that would be to assume no progress in fire prevention either in the conduct of factory operations or in the design of buildings.

The Glasgow whisky warehouse fire, if it is assumed to have cost between £5 and £10 million, will carry the fire loss account for the first quarter of this year to about half of all the losses of last year (£44 million) and to more than the entire cost of 1958's fires.

This is a speed of increase far beyond a simple rise associated with increased industrial activity. Even without the Glasgow disaster—the February figure of fire losses this year was agreed to be £6,189,000, not far removed from the record month of October last year (£6,416,000).

There are three main weapons in preventing fires from ever starting. First, given that the conditions of the factory are reasonable, is the watchfulness of every person there. This is a matter of training, example and discipline. Equally important is the design of the plant, of ventilating systems of storage facilities. Not all costly industrial fires take place in old buildings.

Also important is the planning of production methods in a way that does not put cables, materials and operatives into fire-likely combinations.

The Glasgow deathroll occurred at a bonded warehouse, but it is a warning of what could happen at serious industrial fires should the firemen's luck run out.

and Small Reactors

The ideal situation for a nuclear reactor is one in which maximum advantage can be taken of its unique character. So far, the main impetus to the development of nuclear power has been the anticipated world-wide shortage of other fuels. But nuclear fuel is not merely a substitute for other fuels, it has special qualities of its own. It is compact and may last for several years without replenishment. The perfect location for a nuclear reactor should therefore be one with no local fuel, no grid system and poor transport facilities. Such a remote and backward area would be unlikely to support a large power demand. At least in the initial stages, a comparatively small reactor would be needed.

Throughout the world there are territorial pockets where, for one reason or another, atomic power is already competitive with other power sources. As nuclear experience grows and conventional fuels become more scarce, the break-even contour lines that contain these areas will expand, embracing ever wider territories.

Initially at least the small reactor, involving only a moderate investment, is likely to prove most successful in these areas.

Because market opportunities for small reactors appear to be promising, ENGINEERING has invited the heads and chief project engineers of nuclear departments in leading British concerns to contribute articles describing their companies' small-reactor projects. Prepared exclusively for ENGINEERING, these articles are to be published in next week's issue, together with tables listing names, addresses, associates and activities of British reactor companies

Corrosive Wear of Cast Iron

Contrary to expectations, increasing silicon content of pearlitic flake-graphite cast irons, between 0 and 2 per cent, does not always serve to increase corrosion resistance.

Recent studies by Shell Research and the Fulmer Research Institute have thrown important new light on the problem of corrosion in cast iron. They were described in the paper "The Influence of the Silicon in Cast Iron on Corrosive Wear," by Graham, Prado and Collins of Shell Research, and Brandes and Farmery of the Fulmer Research Institute, recently published in the *Journal* of the Institution of Mechanical Engineers.

This paper shows that the corrosion of cast iron cylinder liners and piston rings in diesel engines, caused by acids in combustion gases, occurs at a maximum rate when the silicon content is about 2 per cent. Reduction of the silicon content to 1 per cent produces a marked improvement in corrosion resistance.

Similar results were obtained from experiments with boiler gases. While the influence of silicon is not yet fully understood, and further studies will be necessary, the indications already obtained are clear enough to be of great importance to all who are concerned with the many problems that arise when cast iron is exposed to corrosion by acids.

In certain types of machinery, cast iron parts are exposed to both abrasive and corrosive wear. Abrasive wear is the simple erosion of surfaces caused by their rubbing together; with corrosive wear, the metal is lost through direct chemical attack on working surfaces.

A cast iron containing between 1 and 3 per cent silicon is considered the most satisfactory for resisting abrasive wear. A much higher silicon content, on the other hand, is known to provide good resistance to corrosion; in fact, an iron containing 14 per cent silicon is the standard material for use with sulphuric acid. It had therefore been assumed that for cast iron with a silicon content in the 1 to 3 per cent range, the higher silicon content would give the better resistance not only to abrasion, but also to corrosion.

That this might not be so was suspected when samples from 24 cylinder liners, which had suffered excessive wear in marine two-stroke diesel engines, were examined at the Thornton Research Centre of Shell. One of these is shown in Fig. 1. Corrosion is a major cause of wear in diesel engines, through the condensation of combustion products containing acids.

Laboratory corrosion tests at Thornton suggested that silicon might have an adverse effect on the corrosion resistance of cast iron. Results indicated that the increase in corrosion when the silicon content was raised from 0·8 per cent to 1·8 per cent was nearly tenfold.

These first tests were limited in their scope. The highest silicon content used was about 1·8 per cent and the samples differed not only in silicon content but in other respects, such as constituents and microstructure. The results were felt to justify taking the matter further, by carrying out further tests under more carefully defined experimental conditions.

The Fulmer Research Institute was therefore asked to cast and prepare suitable specimens differing as far as possible only in silicon content, and to test them in their laboratory. Ten cast irons of similar structure but ranging in silicon content from 0·59 to 2·96 per cent, were produced and tested. The cast irons were pearlitic, flake-graphite irons with well distributed phosphide phases. These tests at Fulmer fully confirmed the earlier results at Thornton, and indicated that resistance to corrosion was lowest where the silicon content was just above 2 per cent that is illustrated by the curve in Fig. 2.

Further tests were then carried out at Thornton to examine the effect of the silicon content under operating conditions. Piston rings were machined from two of the pearlitic castings made at Fulmer containing 1 per cent and 2 per cent silicon respectively, and tested in a diesel engine under conditions including those which encouraged formation of acid condensate. These results also confirmed that the cast iron with the lower silicon content had substantially greater resistance to corrosive wear than that with the higher content (see Fig. 3). This was found to be so, although naturally to a lesser degree, even when a lubricating oil with additives designed to combat corrosion was used.

It was realised that the results obtained at Fulmer were significant not only for problems connected with diesel engines. The corrosion of cast iron can be a problem wherever this metal is used; it may be exposed to acids in industrial plant, for example, or merely in the atmosphere of large cities.

Specimens of these cast irons were therefore tested in boiler combustion gases at Thornton. In this case samples were inserted in a probe, so arranged that the temperature of the sample could be reduced below the dewpoint. The probe was exposed to products of combustion of normal fuels. In comparison with the results of the engine tests the effect of silicon in these boiler tests was significant enough to emphasise the importance of a low silicon content. Here the greatest corrosion occurred when the silicon content was about 1½ per cent, rather than just over 2 per cent as in the previous tests.

Further work will be necessary to reach a fuller understanding of the influence of silicon in the corrosion of cast iron. Most of the work reported, for example, was done with cast iron chosen for its suitability in engines and machinery, and there is no direct evidence yet that the results will hold for other types.

The conclusion already drawn, however, should be of great importance to all concerned with the use of cast iron where it is exposed to corrosion by acids. It has now been clearly shown that the higher silicon contents often chosen to facilitate the production of sound castings for certain machinery can result in the worst resistance to corrosion. For the best resistance, the silicon content must be kept low; certainly not higher than 1 per cent, and if possible lower still.

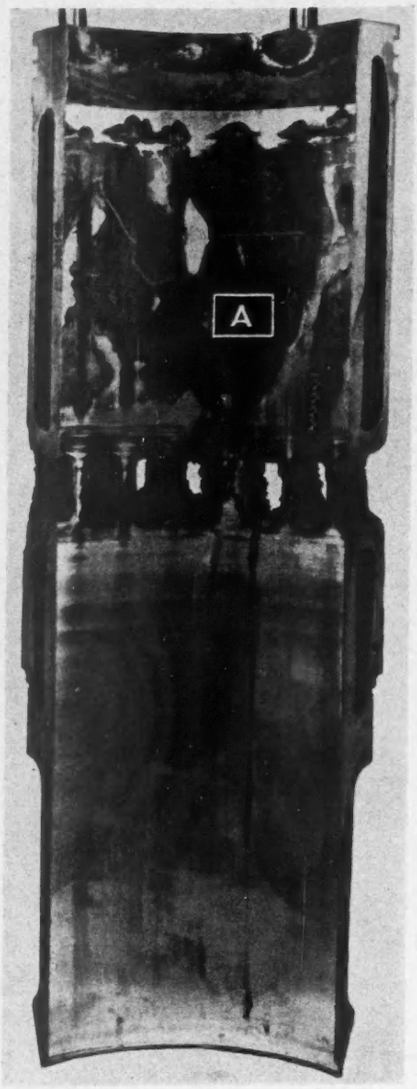


Fig. 1 (right) Sectioned two-stroke diesel engine liner attacked by acid condensate. Bottom section shows 100 × enlargement of area A.

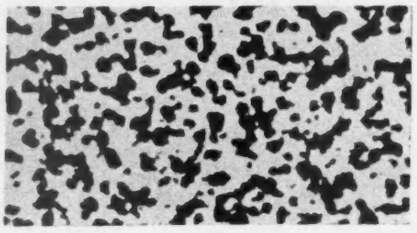
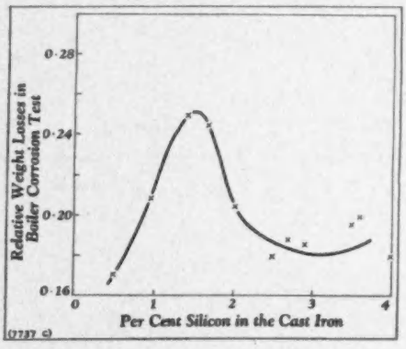
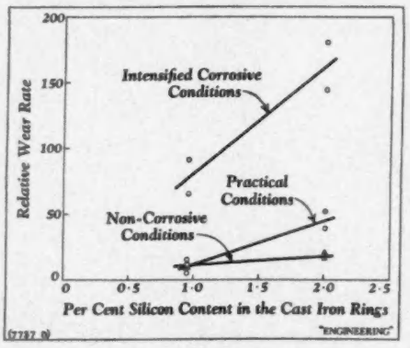


Fig. 2 (bottom right) Wear of cast iron piston rings in engine tests.

Fig. 3 (bottom left) Attack of cast irons with different silicon contents in a boiler.





Promising Uses for "Wet Cardboard"

Polygorskite has a habit which not many people know about. What is more it goes around disguised as wet cardboard. Polygorskite, according to two staff members of the American General Electric Company, is widely known as "mountain leather," "mountain cork," or "mountain wood." They relate that a geologist visiting a mine in search of the material once said that he felt some embarrassment in picking up the deposits, since they might prove to be crumpled lunch bags discarded by the miners.

The habit of polygorskite may be the cause of anything but disrepute—for another staff member of General Electric has discovered that it can be formed into flat sheets by standard paper making techniques, and has reported that the mechanical and electrical properties are comparable with those of insulating paper made from mica. It looks, therefore, as though there is a fellow for that other oddity, phlogopite (for background see ENGNG., 25 Sept. '59, p. 260). Polygorskite could be a substitute for dielectric paper used in capacitors and transformers, and has also shown itself able to withstand 900° F.

General Electric's ardour was dampened in their researches because they couldn't find any of the material; that is, until they met people who represented certain Californian and Brazilian interests who surprisingly had "hundreds of thousands of tons of it." Polygorskite, incidentally, resembles asbestos and is described as a hydrous magnesium aluminium silicate. Its habit is fibrous.

Growth and Oxidation Resistant Cast Iron

Spheronic is a new cast iron which has been evolved from the spheroidal Ni-cast irons and the oxidation resistant irons containing silicon. So far it is giving extremely encouraging results for heat resisting applications.

Typical of the Ni-cast irons is Ni-Resist, made by INCO-Mond and containing about 14 per cent nickel and 6 per cent copper. The strength and oxidation resistance of this was improved when, in 1947, the organisation announced methods of producing cast irons with graphite in spheroids instead of in the flake form. The desirable stable austenitic structure was retained and the material is now known in Great Britain as SG Ni-Resist.

In mechanical properties, SG Ni-Resist and Spheronic are similarly strong—approximately two and a half times that of ordinary flake-graphite Ni-Resist. Thus at 700° C a single investigation by BCIRA has shown the 0·2 per cent proof stress of SG Ni-Resist to be 10·3 ton per sq. in with an elongation of 14 per cent, while with Spheronic the corresponding figures are 10·8 and 33 respectively, and with flake graphite Ni-Resist are 6·6 ton per sq. in ultimate strength with 1 per cent elongation.

In resistance to scaling Spheronic is outstanding. Test bars were maintained at a temperature of 950° C for two months during which period they were withdrawn from the furnace and cooled to room temperature each working day, thus accelerating the scaling action. In one instance, the Spheronic bar lost only 10 per cent in weight, the SG Ni-Resist 61 per cent, and the flake-graphite Ni-Resist 81 per cent.

S. Russell and Sons Limited, Bath Lane, Leicester.

Self-Adhesive Foil Nameplates

If you know what a metal-cal is then you will realise that this implies an outlet much larger than that associated with "nameplate." Whatever name they parade under, the fact remains that Malby's Metal-Cals are now making these from aluminium foil backed with an adhesive which resists varying conditions of temperature and humidity.

Metal-cals come with a cellophane backing which must be removed before application. This is done by immersing in warm water for 40 to 60 seconds to soften the rubber adhesive, followed by blotting off the moisture, and peeling off the backing. Surfaces should be degreased with a solvent such as acetone, following which the adhesion is good to almost all materials—metal or plastics—except polyethylene. Shaping is not necessary as the flexible metal-cals conform to surface contours, and the adhesion is said to be so good that the metal-cals defy all efforts to remove them short of chipping or grinding.

Thorough tests have been carried out to the satisfaction of the Ministry of Supply, Royal Aircraft Establishment, Signals Research and Development Establishment, and AID Laboratories. On weathering over 18 months in RAE tropical exposure tests in conditions of not less than 90 per cent humidity. the metal-cals have shown no signs of corrosion or serious loss of adhesion.

They are supplied in various shapes within the limits of 9 × 13 in or in strip form when additional marking is called for. Normal marking is performed by the makers, and there is a minimum charge to include making printing plates which would limit use under most circumstances to large numbers off. A typewriter in the stencil position can be used to add serial numbers and the impressions so formed in the 0·003 in thick aluminium are quite lasting.

Metal-cals are already being used on domestic equipment by manufacturers such as Hoover and E. K. Cole, and Rolls-Royce apply them to the cowlings of some of their aircraft engines.

Malby's Metal-Cals Limited, Queens Park Road, Brighton 7, Sussex.

25Ni-Steels Stronger yet Ductile

The International Nickel Company confirms that a new family of very high strength Ni-steels has been invented in the research laboratories of the company.

Nominally identified as 25Ni-steels, these alloys achieve unique properties by simply air cooling from the heat treating temperatures. Yield strengths in excess of 250,000 lb per sq. in with 6 to 10 per cent elongation and above 20 per cent reduction of area are obtainable in section thicknesses where such high strength properties were not before attained. In some cases yield strengths in excess of 290,000 lb per sq. in have been achieved. Maximum hardness in excess of 67 Rockwell C (about 1,000 VPN) has been obtained.

Many of these new steels also possess excellent cold forming characteristics after a simple annealing treatment which consists merely of air cooling from solution temperature. In this condition, they have a yield strength of the order of mild steel.

The fact that the high strength properties are obtained without liquid quenching means that intricate parts can be fabricated to close tolerances while the steel is in its soft annealed condition and can be hardened to these high strength levels without appreciable distortion. This factor together with the high order of mechanical properties attainable should make the steels of particular interest for applications in aircraft and missiles, say INCO, and for high strength wear resisting precision parts such as bearings.

An unusual feature of the 25Ni-steels is that they are weldable in the hardened condition without preheating. This could make them useful for heavy wall pressure vessels. According to INCO these steels are readily hot worked, and although they were not commercially available last November there is nothing to prevent them being made in normal mill sizes including bars, plate, sheet and tubing.

Although the combination of mechanical properties is affected by varying the nickel content from as high as 30 per cent down to 20 per cent or lower, with suitable additions of titanium and aluminium, the optimum combination of strength and ductility appears to be at about 25 per cent nickel, with 2 to 6 per cent titanium and/or aluminium, carbon held as low as possible and preferably below 0·05 per cent, silicon and manganese normal, and balance iron.

The patent application by INCO indicates that the inclusion of aluminium and titanium in the range cited makes the steels responsive to both precipitation and martensitic hardening. By a combination of these hardening mechanisms in proper sequence and through appropriate control of time and temperature during heat treatment, the properties can be controlled over a broad range.

International Nickel Company, Inc., 67 Wall Street, New York 5, NY, USA.

Refrigerator has Plastic Kick Plate

The refrigerator-making industry has few inhibitions about using new materials and plastics are featured widely in their products. High-impact pvc and polystyrene liners and door liners, plastic trays and panels, ice-box doors, temperature control knobs and mounting plates can all be noted. To keep the heat out, expanded polystyrene is a popular insulant. Now Lec Refrigerators of Bognor Regis incorporate a kick

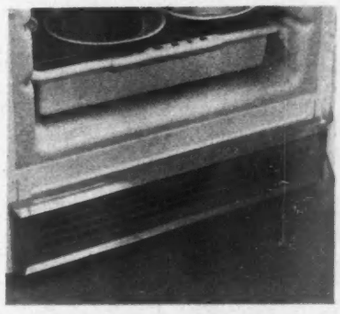


plate moulded in high density polyethylene supplied by British Resin Products.

The grille allows air to circulate around the motor compressor and must withstand knocks and kicks. The grille, which has 93 holes, has a smooth surface finish, has good abrasion resistance and is easy to keep clean. It is, of course, completely resistant to the "chemicals" likely to be found in a home, and to oils and greases.

Deaden that Panel

Dedshete is a sound-deadening material in flexible sheet form for the suppression of drumming and tinniness in sheet metal. It ensures a high rate of sound decay, and is said to be unequalled by any known product of comparable nature. An incidental advantage is that it provides an effective seal for lap and butt joints.

The sheet material is self-adhering and requires no brushing, spraying or prefixing; simply lay it on the metal, and stove for five minutes at 300° F. It is flexible and moulds itself to any contour during stoving on horizontal or inclined surfaces not exceeding 30°. Adhesion is permanent and once applied Dedshete may be restoved in any plane or position at temperatures up to 350° F without adverse effect. It will readily adhere to stock oiled metals, and adhesion is unaffected by subsequent phosphating or similar prepainting treatment, hot water, detergent or dilute acids and alkalis.

Since it contains 99 per cent solids, there is said to be no risk of fire in its application. Dedshete can be supplied cut to fit panels of any size and shape up to 42 × 30 in.

Supra Chemicals and Paints Limited, Tipton, Staffs.

Plain Words

By Capricorn

ENGINEERS and engineering, apart from their direct services to mankind, have made available a number of techniques which are now applied in non-engineering situations. Time and motion study and various statistical methods are typical. Communication engineering is beginning to contribute something to the science of communication by language, but otherwise I think we have accepted for too long the idea that writing is an art which can only be developed by arts men.

Our English habit of placing adjectives before nouns seems to me to be much less logical than the French method. You have to carry the adjectives in your mind until you reach the noun; only then do all the words convey their meaning. If you go into the grocer's and ask for a pound of pork sausages, the assistant cannot begin to attend to your order until you reach the last word—" sausages." If you said " Sausages, pork, one pound, please " you would cut out that slight delay.

I tested this theory last week. The female assistant in the grocer's shop I often visit is marvellously deft. She would delight a motion study man by her perfectly co-ordinated, unwasteful movements. She changes the weights on the scales, pops the goods in paper bags, turns the top of the bag and handles the cash, all with the minimum of effort and delay. Such a skilled worker would surely respond to my carefully designed ordering technique.

" Sausages, pork, one pound, please," I said. For the brief time it takes to say those five words clearly, her hands remained motionless and idle. She stared, seemed to make a difficult calculation in her mind, and then moved to the tray of sausages. The whole operation almost certainly took slightly longer than usual. She probably had to change the order of words before she could act.

There is a time honoured precedent for my reverse order technique. The Army catalogues stores in this way. You find such quaint items as " Pin, split, retaining spring retaining sear." At least you know it is a split pin even if you don't understand its function.

On the allied problem of finding a new word to describe a new component or machine, engineers seem to do best when they adapt an existing word rather than coin a new one. Whether the word is " pin " or " computer " everyone accepts it, but when we come out with " dynamo " or " automation," it is soon used as a synonym for tycoon or it is bandied about politically and all the meaning is knocked out of it.

On the larger questions of language and communication, I shall go on hoping that some day, somehow, science and engineering will point the way to better ways of using words. Next week in New York there is to be a symposium on " Basic Questions in the Structure of Languages." Maybe something is stirring already.

Letters to the Editor

London's Traffic Termini

SIR, Rather than convert London's main-line railway approaches into roads, as suggested in Brigadier T. I. Lloyd's letter on the " Need for a Review of Wheeled Traffic " (ENGNG., 4 Mar. '60, p. 312), could they not be used more efficiently as *railways* by moving the long-distance termini to stations on the perimeter, and running underground-type trains (diesel-electric powered) on the inner sections thus released?

During rush hours, these trains could arrive or leave the central termini at, say, one train per minute, using in rotation the many platforms available. The rapid removal of empty trains after use during the inward morning rush, and the rapid feeding-in of sufficient empty trains in the evening to take the outflow, would, of course, present serious problems; and for outgoing rush hours some form of passenger switching would probably be needed to ensure that each train was properly filled (but not overfilled) before leaving, and to divert the passenger feed, say 30 seconds before each train left, to the next train.

All this would be difficult and expensive, but it would clearly represent a more efficient use of " channel widths," vehicle accommodation, and energy expenditure than would filling up the system with a hotchpotch of assorted individual cars, with widely different sizes, shapes, capacities (usually not fully taken up) and performances (especially in acceleration and deceleration).

It could also lead to more people getting where they wanted more quickly and in a better state of mind, with a consequent improvement in their efficiency and reductions in their ulcer and divorce rates. It could even reduce road casualties.

Yours faithfully,
BRUCE M. ADKINS.

5 Rue Fournier,
Fontenay-aux-Roses,
Seine, France.
29 March, 1960.

NSU-Wankel Engine

SIR, In your Automobile Review article on the NSU-Wankel engine (ENGNG., 25 Dec. '59, p. 676), you illustrate a two-node epitrochoid fixed casing with only two moving parts—a rotor and an output shaft: the rotor being geared to a pinion fixed to the end casing at a ratio of 2 : 3.

In column two it says " the speed of the rotor is *two-thirds* of the speed of the shaft." Should this not have been *one-third*? The angular velocities appear to me to be 30° to 90°.

I am, Sir,
Yours sincerely,
J. VINCE.

Norwin,
Ruislip Common, Middlesex.
26 March, 1960.

Editor's Note.—The writer is correct. The makers of the engine state that: " The runner of the rotary piston engine has the shape of a modified equilateral triangle. It is mounted on an eccentric and rotates at 2/3 the angular speed of the shaft in the opposite direction, hence 1/3 the angular speed of the shaft related to the stationary frame."

Decisions by Computer

SIR, Mr. E. R. Davies's article on " How Computers Help to Make Decisions " (ENGNG., 18 Mar. '60, p. 382) is an excellent summary of the commercial use of computers today. It also serves to stress their shortcomings.

In general terms, electronic digital computers can be used in any system where the human brain is used to sort and process information whether it be numbers or logical symbols. Problems may be of the form of Mr. Davies's example of working out stresses in bridges, or they may be a logical problem, such as a delivery schedule for a manufacture; for example, A must receive delivery on Monday, B cannot receive delivery on the same day as A as he is on the other side of town, C requires delivery every other day but not on the same day as B as they both have big orders which would require more than one van trip, D can receive delivery on the same days as both A and C but not E, and so on.

Despite an amount of high-pressure salesmanship there are still a large number of possible computer users who do not appreciate the kind of work that can be done by a computer and the advantages a computer could perhaps offer them in time saving, accuracy and cost—this is where articles like Mr. Davies's help. Of those who have tentatively considered using a computer, many have shied back when faced with the prospect of many moons of programming their problem with its consequent cost. Even though programme libraries of some substance have been collected for a few of the established computers, the number of occasions on which one finds one can use someone else's programme in its entirety without having to make difficult alterations is very few. For industry to reap the benefit of increased efficiency from the use of computers, the computer manufacturers have to do more than sell the idea, they have to ensure that the product they offer is extremely easy to use and is adaptable to the requirements of differing applications. In hard cash, this means cheaper programming and better utilisation.

An example from the new generation of computers which goes a long way towards meeting these criticisms is the De La Rue Bull machine Gamma 60. To make programming easier, it may be programmed in any way of four codes: the machine functions, the machine autocode, and two " universal " codes.

Although this renders the translation of the problem from the mathematical form to a form in which the machine can ingest it a job for a junior, we are still some way from the ultimate when the machine will accept the problem in the logical form, and sort out its own mathematical numerical analysis.

The other prerequisite is to have a flexible assembly of units. The finesse of the Gamma 60 is that although the units are " tied " together into one assembly, they are capable of limited separate existence and several processes, for example, arithmetic and printing can go on at the same time, where a demand exists for the use of a unit by two of the other units then the computer is capable of assessing priorities and allotting the required unit so that the best overall efficiency is obtained. This represents a big advance in computer design, and of particular advantage in some business applications where a unit, for example, the printing unit, has to be used up to its maximum capacity and not be limited by the overall programme.

Yours faithfully,
A. H. DUNCAN.

c/o Officers' Mess,
Boscombe Down, Amesbury, Wilts.
27 March, 1960.

Information by Television

SIR, May I ask, through you, if Mr. F. H. Smith will be good enough to amplify his statement in On the Shelf (ENGNG., 18 Mar. '60, p. 394) that closed circuit television will do librarians " harm " and reduce a " research worker's instincts to find out for himself."

Does not Mr. Smith use the telephone? CCTV is simply another device to let research workers, in our case half a mile away, see what they know they want.

Yours faithfully,
L. L. ARDERN,
Librarian.

College Library,
Manchester College of Science and Technology,
Manchester 1.
24 March, 1960.

Events in Advance

Endurance of Electrical Materials and Structures

Arrangements are being made by the Measurement and Control Section of the Institution of Electrical Engineers, in association with the British National Committee on Non-Destructive Testing, to hold a conference on non-destructive testing in electrical engineering. The conference will take place at the headquarters of the Institution from Wednesday, 8 November, to Friday, 10 November, 1961. The general theme for discussion will be " How Best May the Electrical Engineer Test the Quality and Endurance of His Structures and Materials?"

Offers of papers for reading at the conference will be welcomed. Anyone desiring to submit a paper for consideration by the organising committee of the conference should communicate with the secretary, the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (Telephone: COVent Garden 1871.) Further particulars regarding the scope of the conference, and other details, may also be received from him.

Exhibitions and Conferences

Solid State Microwave Amplifiers, Conference.—Wed., 6 April, to Fri., 8 April, at The University, Nottingham. Apply to the secretary, Institute of Physics, 47 Belgrave Square, London, SW1. Tel. BELgravia 6111.

Aslib Electronics Group, Second Annual Conference.—Fri., 6 May, to Sun., 8 May, at Ashridge College, Berkhamsted, Hertfordshire. Aslib offices: 3 Belgrave Square, London, SW1. Tel. BELgravia 5050.

Standards Engineers' Conference, Sixth.—Wed., 11 May, at the Connaught Rooms, Great Queen Street, London, WC2. Tickets £1 15*s* 0*d*. Organised jointly by the Institution of Production Engineers, 10 Chesterfield Street, London, W1 (Tel. GROsvenor 5254), and the British Standards Institution, 2 Park Street, London, W1. Tel. MAYfair 9000.

Munich International Handicrafts and Trade Fair.—Wed., 11 May, to Sun., 22 May, at Munich. Offices: 14 Theresienhöhe, Munich 12, Germany.

Illuminating Engineering Society, Summer Meeting.—Sun., 15 May, to Wed., 18 May, at Harrogate. Society's offices: 32 Victoria Street, London, SW1. Tel. ABBey 5215.

Nylon in Industry: Convention.—Wed. and Thurs., 25 and 26 May, at Park Lane House, London, W1. Organised by British Nylon Spinners Ltd., 68 Knightsbridge, London, SW1. Tel. KENsington 6333.

Use of Aluminium in Railway Rolling Stock, Symposium.—Fri., 27 May, at the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Organised jointly by the Institution of Locomotive Engineers, 28 Victoria Street, London, SW1 (Tel. ABBey 6672); and the Aluminium Development Association, 33 Grosvenor Street, London, W1. Tel. MAYfair 7501.

British Plastics in the USSR, Exhibition.—Fri., 3 June, to Fri., 17 June, in the Polytechnical Museum, New Square, Moscow; Fri., 15 July, to Sat., 30 July, in the Exposition Pavilion, Park of Kirowa, Leningrad. Organised by the Plastics Division of Imperial Chemical Industries Ltd., Millbank, London, SW1. Tel. VICtoria 4444.

Industrial Photoelasticity, Summer Course in.—Mon., 27 June, to Fri., 1 July, at Massachusetts Institute of Technology. Apply to the Director, Massachusetts Institute of Technology, Cambridge 39, Mass., USA.

Institution of Mining Engineers, Summer Meeting.—Wed., 29 June, to Fri., 1 July, at the Park Hotel, Park Place, Cardiff. Institution's offices: 3 Grosvenor Crescent, London, SW1. Tel. BELgravia 3691.

Medical Electronics, Third International Conference and Associated Scientific Exhibition.—Thurs., 21 July, to Wed., 27 July, at Olympia, London, W14. Organised, in association with the International Federation for Medical Electronics, by the Electronics and Communications Section of the Institution of Electricl Engineers, Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871.

Royal Institution of Chartered Surveyors, Annual Conference.—Tues., 30 Aug., to Sat., 3 Sept., at the University College of North Wales, Bangor. Institution's offices: 12 Great George Street, London, SW1. Tel. WHItehall 5322.

Russian for Scientists, Intensive Residential Course on.—Mon., 12 Sept., to Sat., 24 Sept., at the Chancellor's Hall, Edgbaston, Birmingham. Organised by the University of Birmingham. Fees: £25 for residents; £15 for non-residents. Closing date for applications 31 May. Forms obtainable from the secretary, Russian for Scientists Course, University of Birmingham, Edgbaston, Birmingham 15.

Diamond Physics, Conference.—Thurs. and Fri., 22 and 23 Sept., in the New Physics Laboratory, The University, Reading. Sponsored by the Physical Society, 1 Lowther Gardens, South Kensington, London, SW7. Tel. KENsington 0048. Apply to Dr. C. D. Clark, Physics Laboratory, Whiteknights Park, Reading, Berks.

Reinforced Plastics, Second International Conference.—Wed., 30 Nov., to Fri., 2 Dec., at the Café Royal, 64 Regent Street, London, W1. Organised by the British Plastics Federation, 47-48 Piccadilly, London, W1. Tel. REGent 2041.

Engineering, Marine, Welding and Nuclear Energy Exhibition.—Thurs., 20 April, to Thurs., 4 May, 1961, at Olympia, London, W14. Organised by F. W. Bridges and Sons, Ltd., Grand Buildings, Trafalgar Square, London, WC2. Tel. WHItehall 0568.

Meetings and Papers

British Institution of Radio Engineers

LONDON
" Guided Weapon Control," by F. R. J. Spearman. Computer Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 13 April, 6.30 p.m.*

MANCHESTER
" The Measurement of Human Performance," by H. Woolf. North Western Section. College of Technology, Sackville Street, Manchester. Thurs., 14 April, 6.30 p.m.

Chemical Engineering Group

LONDON
" Developments in Factory Floorings," by S. C. Chigison. Tues., 12 April, 6 p.m.

Combustion Engineering Association

BIRMINGHAM
" Industrial Space Heating," by F. R. Colton. Midland Region. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2. Thurs., 14 April, 10.15 a.m.

Illuminating Engineering Society

SHEFFIELD
" Industrial Lighting," by R. H. Sanders. Annual General Meeting. Sheffield Centre. Grand Hotel, Sheffield. Mon., 11 April, 6.30 p.m.

Institute of Fuel

MANCHESTER
Annual General Meeting. North Western Section. Engineers' Club, Albert Square, Manchester. Wed., 13 April, 2.30 p.m.

Institute of Marine Engineers

LONDON
" Pollution of the Sea by Oil," by Dr. L. R. B. Shackleton, E. Douglas and T. Walsh. Tues., 12 April, 5.30 p.m.*

Institute of Metal Finishing

BIRMINGHAM
" The New Ford Paint Finishing Plant," by I. Walker. Organic Finishing Group. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2. Wed., 13 April, 6.30 p.m.

Institute of Welding

LONDON
" Prospect for Welding ": Discussion. Annual General Meeting. South London Branch. Wed., 13 April, 7.30 p.m.*

Institution of British Agricultural Engineers

LONDON
" Some Aspects of Mechanisation in Underdeveloped Territories," by Dr. W. D. Raymond. Tues., 12 April, 2.15 p.m.

Institution of Electrical Engineers

LONDON
" Public Lighting ": Discussion, opened by A. E. J. Whitcher. Mon., 11 April, 5.30 p.m.*
" Aids for the Blind ": Discussion, opened by Lord Fraser of Lonsdale and R. L. Beurle. Medical Electronics Discussion Group. Tues., 12 April, 6 p.m.*
" Water-Turbine-Driven Induction Generators," by C. L. C. Allan. Supply Section. Wed., 13 April, 5.30 p.m.*

BELFAST
" Subscriber Trunk Dialling," by D. A. Barron. Northern Ireland Centre. David Keir Building, Queen's University, Stranmillis Road, Belfast. Tues., 12 April, 6.30 p.m.

CHRISTCHURCH
" Provision of Adequate Electrical Installations in Buildings ": (*a*) " Houses," by C. C. Hyams; and (*b*) " Multi-Storey Flats and Maisonettes," by C. A. Belcher. Southern Centre. King's Arms Hotel, Christchurch. Wed., 13 April, 6.30 p.m.

EDINBURGH
" High-Current-Density Thermionic Emitters: A Survey," by A. H. W. Beck. South East Scotland Subcentre. Carlton Hotel, North Bridge, Edinburgh. Wed., 13 April, 7 p.m.

GLASGOW
" High-Current-Density Thermionic Emitters: A Survey " by A. H. W. Beck. South West Scotland Subcentre. Royal College of Science and Technology, Glasgow. Tues., 12 April, 6 p.m.

NEWCASTLE UPON TYNE
Annual General Meeting and Conversazione. North Eastern Centre. Royal Station Hotel, Newcastle upon Tyne. Mon., 11 April, 6.15 p.m.

Institution of Engineers-in-Charge

LONDON
" Power Capacitors and Their Application to Industry," by G. E. Bishop. Caxton Hall, off Victoria Street, SW1. Wed., 13 April, 6.30 p.m.*

Institution of Heating and Ventilating Engineers

LONDON
Annual General Meeting and Presidential Address. Federation of British Industries, 21 Tothill Street, SW1. Wed., 13 April, 6 p.m.

NEWCASTLE UPON TYNE
Annual General Meeting. North East Coast Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Tues., 12 April, 6.30 p.m.

Institution of Mechanical Engineers

LONDON
" Performance Testing of the Complete Car," by Dr. A. Fogg. Automobile Division. Tues., 12 April, 6 p.m.*
" Development of Multi-Fuel Engines," by G. K. Martlew. Wed., 13 April, 6 p.m.*

GLASGOW
" Transport on and Under the Sea," by W. A. Crago and E. Norton. Leonardo da Vinci Lecture. Scottish Branch. Royal College of Science and Technology, Glasgow. Tues., 12 April, 10.30 a.m. and 2.30 p.m. Admission to schoolchildren of 15 years and upward by ticket obtainable free, from school authorities.

WEYBRIDGE
" Structural Aluminium Alloys for High-Speed Flight," by W. M. Doyle. Southern Branch. Joint meeting with the Royal Aeronautical Society. Apprentices' Training School, Weybridge. Wed., 13 April, 6.10 p.m.

Institution of Plant Engineers

BRISTOL
" Problems Encountered with the New Sewage Scheme," by J. H. Begg. Western Branch. Grand Hotel, Broad Street, Bristol. Wed., 13 April, 7.15 p.m.

DUNDEE
" Types and Uses of Eutectic Welding Alloys for Engineering Purposes ": Discussion. Dundee Branch. Taypark Hotel, West Ferry, Dundee. Wed., 13 April, 7.30 p.m.

MANCHESTER
" Some Recent Aspects of Space Flight," by J. E. Allen. Manchester Branch. Engineers' Club, Albert Square, Manchester. Tues., 12 April, 7.15 p.m.

NEWCASTLE UPON TYNE
" Some Applications of Plastics in Industry ": Discussion. North East Branch. Roadway House, Oxford Street, Newcastle upon Tyne. Thurs., 14 April, 7 p.m.

Institution of Production Engineers

BRIGHTON
" Practical Training for the Future Production Engineer," by F. W. Cooper and E. R. Cash. Annual General Meeting. London-Brighton Group. Royal Pavilion Hotel, Castle Square, Brighton. Wed., 13 April, 7 p.m.

BRISTOL
" Research for Consumers: New Aims, New Methods," by J. G. S. H. Mitchell. Western Graduate Branch. Royal Hotel, Bristol. Mon., 11 April, 7.30 p.m.

Royal Aeronautical Society

LONDON
" On Reducing Costs of Space Research," by J. E. Allen. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 21 April, 6 p.m.*

Royal Meteorological Society

LONDON
Presidential Address, by Dr. J. M. Stagg. Annual General Meeting. Wed., 20 April, 5 p.m.*

Royal Statistical Society

LIVERPOOL
" The Effort of Inspection," by Dr. S. Broadbent. Merseyside Group. Department of Education, University of Liverpool, Abercromby Square, Liverpool. Tues., 12 April, 7 p.m.

Society of Instrument Technology

BRISTOL
Film Evening and Annual General Meeting. Bristol Section. Department of Physics, University of Bristol, The Royal Fort, Bristol 8. Thurs., 14 April, 7.30 p.m.

MANCHESTER
" Recent Railway Signalling Developments ": Discussion. Manchester Section. Central Library, St. Peter's Square, Manchester 1. Tues., 12 April, 6.45 p.m.

South Wales Institute of Engineers

CARDIFF
Exhibition of industrial films. Thurs., 21 April, 6.30 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Chemical Engineering Group, 14 Belgrave Square, London, SW1. (BELgravia 3647)
Combustion Engineering Association, 70 Jermyn Street, St. James's, London, SW1. (WHItehall 5536)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1. (LANgham 7124)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Metal Finishing. Apply to 11A Gloucester Road, London, SW7. (KNIghtsbridge 9181)
Institute of Welding, 54 Princes Gate, Exhibition Road, London, SW7. (KNIghtsbridge 8556)
Institution of British Agricultural Engineers, 6 Queen Square, London, WC1. (TERminus 0140)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineers-in-Charge, 13 Grange Close, Edgware, Middlesex. (MILl Hill 3543)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London, SW7. (KENsington 0730)
Royal Statistical Society, 21 Bentinck Street, London, W1. (WELbeck 7638)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
South Wales Institute of Engineers, Park Place, Cardiff. (Cardiff 23296)

World Watchmakers Confront the Swiss

The world famous Swiss watch industry has many small firms and has existed for centuries. Its share of the expanding world watch market has fallen from ninety per cent fifty years ago to fifty per cent now.

By Richard Bailey

It is a long established principle of the Swiss that what is good for watchmaking is good for Switzerland.

Watch and clock making has been carried on there for over three hundred years and in the economic sense it is the most sensitive indicator of the state of national prosperity.

How do the moves towards closer economic integration in Europe affect the prospects of the industry, and in particular Swiss membership of the European Free Trade Association? Will the watch makers of the Common Market whose territory borders Switzerland on three sides, enjoy a big advantage from working for a market of 165 million people?

In short, would the Swiss watch industry and by implication the nation itself have done better to have joined up with the Six in the Common Market, rather than continue to follow the traditional policy of political neutrality which seems to rule out such close collaboration?

These questions are dealt with in a most interesting and illuminating way in a recent publication from the Centre de Recherches Européennes at Lausanne.* From this book it is clear that the watch industry is in a state of change not only on the economic and commercial fronts but on the technical side as well. Two major developments now face the industry. The first is the growth of watch and clock making in such countries as Japan which, because of their geographical situation and manufacturing skill, will be very well placed to dominate the markets of India and Africa. The future importance of what are now the undeveloped areas of the world as markets for consumer goods is one of the long-term considerations that many industries besides watchmaking will have to take into account. The other new development facing the industry at the present time is the use of automation in the mass production of the cheaper type of watches. These two changes are of course closely related to the whole question of the Swiss attitude to European integration.

THREE BROAD DIVISIONS

In 1957 Switzerland produced about half the world supply of watches and clocks. For a country with few raw materials and an active and ingenious population watchmaking is the ideal specialisation. The industry is concentrated in a wide arc from Geneva north-eastwards to Schaffhausen. In considerable parts of the Cantons of Vaud, Neuchatel and Berne watchmaking accounts for 95 per cent of industrial activity. The greater part of the Swiss output in this field is of watches. Clocks, of all kinds, only account for from 1 to 2 per cent of production. Of the watches produced some 85 per cent by value and 64 per cent by number are of the jewelled-lever type. The remainder are pin-pallet lever types.

The organisation of the industry is complicated. Some of the biggest makers manufacture all the parts of the watches they produce. Others make some parts and buy the rest. The broad division is into makers of rough movements, makers of individual parts and watchmakers. For the past 30 years these three sections of the industry have been grouped into three professional bodies. These are the Fédération Horlogère (FH) which includes watch manufacturers and assemblers, l'Union des branches annexes de l'horlogerie (UBAH) for small part makers, and Ebauches SA for watch case makers. These associations maintain various price arrangements, conditions of labour and of marketing. The members of FH agree to buy parts and cases only from members of UBAH and Ebauches SA. These three bodies only cover the jewelled-lever section of the industry. The makers of the cheaper pin-pallet lever watches have their own organisation.

What part does watchmaking play in the Swiss economy? In 1958 some 95 per cent of the industry's output was exported representing some 1,118 million Swiss francs (say £100 million). The six Common Market countries took 16 per cent of this, the 17 OEEC countries (including the Six) took 27 per cent. Of the remainder the biggest share went to the United States which took 23 per cent. The biggest customer in Europe was Italy which bought 6·2 per cent of all Swiss watches exported.

On the home front the position of the industry in relation to the rest of the economy is gradually changing. Fifty years ago the textile industry provided half the country's exports, while engineering including watchmaking accounted for 28 per cent. Today textiles are down to 11·9 per cent of exports and engineering has risen to 54·4 per cent. But the position of watch making within the broad category of engineering has gone up only from 12·8 per cent in 1912 to 16·8 per cent today. Machine tools, machinery and instrument making have all grown at a more rapid rate. The chemical industry has increased its exports from 4·7 per cent to 17·1 per cent of the national total in the same period. Looked at from the point of view of the number of workers employed the watch industry has actually lost ground. The labour force in the industry in 1957 represented 9·9 per cent of the national total.

One interesting fact about the location of the watch industry is that it is largely carried on in the five French speaking cantons. Indeed in Neuchatel nearly 60 per cent of the workers are involved in watchmaking. For the country as a whole around 80,000 people, including those working in their own homes, get their living from the industry. At the beginning of the century when Switzerland accounted for 90 per cent of the world trade in watches, this heavy reliance on a single industry was justifiable. Today the Swiss still hold the first place in world trade in watches but their share of production is now down to 50 per cent. And it is still falling.

The main reason for Switzerland's relative decline in importance is that it is more difficult for an old-established industry to expand rapidly than for one newly started. The Russian and Japanese watchmaking industries have literally sprung up from nothing since the war. Russia which was making 700,000 watches a year in 1937 produced 16·4 million in 1957.

One factor which is worrying the Swiss watch makers is the competition of the cheap, factory-made American pin-lever watch. This is feared, not so much for its effects on exports to the United States where high quality watches will always be in demand, but as a portent of the sort of watch that the less wealthy countries will start to ask for as their foreign trade increases. The Swiss industry just is not equipped to turn out mass-produced watches. And the countries of Africa, Asia and South America, with the highest rates of population growth in the world, are not going to be interested in expensive miracles of craftsmanship for many years to come.

MANY SMALL FIRMS

Is there any way out of this difficulty, or will the Swiss watch industry continue its slow decline? Until the last few years the Swiss watches have not had to meet any strong competition from outside. And the conduct of the industry has been regulated with great precision so as to allot a place to each maker of parts, movements or complete watches. The industry has not seen any considerable movement towards concentration into big firms in the last thirty years. Indeed the number of firms with over 500 workers has risen only from 10 to 15 in that period. But the number of one to five man concerns has nearly doubled in that time. All this means a highly individual industry with a great variety of products. Over 120 different types of watch faces are made and something like 1,500 shapes and sizes of watch glasses. Indeed throughout the industry every firm, however small, prides itself on its ability to be able to offer a complete range of its particular products.

In spite of its many problems the Swiss watch industry is undoubtedly prosperous. Leaving aside the tiny concerns that barely make a living for their owners, the profitability of the watch industry has been consistently well above that of Swiss industry as a whole. But only a small proportion of the takings except for the bigger firms is being spent on research. The Swiss Watch Industry's Research Laboratory has an annual income of less than a million francs and appeals for increased contributions from the manufacturers have met with no success.

So although the industry is still the foremost in the world and the names of its principal makers, Omega, Longines, Rolex, Tissot, Patek-Philip, Vacheron-Constantin, Nardin, Eterna, and others, are recognised everywhere as indicating the highest quality, the authors of this study are far from happy about its future. They would like to see the industry adapt itself to the changed conditions in Europe and in the world markets.

World Production of Watches
In millions

Country	1937		1950		1953		1957	
	Watches	Per cent	Watches	Per cent	Watches	Per cent	Watches	Per cent
Switzerland	24·7	51·0	25·3	52·2	34·4	53·6	41·2	48·3
Germany	5·7	11·7	3·5	7·2	5·9	9·2	7·9	9·2
France	2·9	6·0	4·0*	8·3	4·0*	6·3	5·2	6·1
Great Britain	—	—	1·4	2·9	2·3	3·6	2·5	2·9
Western Europe	33·3	68·7	34·2	70·6	46·6	72·7	56·8	66·5
USSR	0·7	1·4	2·1	4·3	4·9	7·6	14·0*	16·4
Japan	1·0	2·0	0·7	1·4	1·6	2·5	3·4	4·0
United States	12·1	25·0	9·8	20·2	8·4	13·1	7·9	9·2
Others	1·4	2·9	1·7	3·5	2·6	4·1	3·3	3·9
Non-European watches	15·2	31·3	14·3	29·4	17·5	27·3	28·6	33·5
World production	48·5	100	48·5	100	64·1	100	85·4	100

* Estimated.

Source: Swiss Chamber of Watches.

* *L'Horlogerie et l'Europe* by Henri Rieben, Madeleine Urech and Charles Iffland.

Details of the Cross-Channel Bridge

A bridge across the Channel is technically feasible. It would cost twice the proposed tunnel but would cater for both road as well as rail traffic. Much repeated prefabrication of large components could make the bridge an economic structure.

With the report of the Channel Tunnel Study Group in the hands of the Government, a reassessment of the possibilities of a bridge between Britain and France has been published by the Compagnie Francaise d'Entreprises. Their plans have been prepared in conjunction with Dorman Long (Bridge and Engineering) Limited and Merritt-Chapman and Scott Corporation of America. Coming from such a combination of companies, having as they have an unrivalled experience of major bridge construction, there can be little doubt that the proposition is technically feasible.

The basis of the design is the repeated use of large standardised elements for both the substructure and the superstructure. The piers would be built up from heavy precast rings of reinforced concrete superimposed one above the other until the required height was reached. The standard spacing of the piers would be 740 ft. Cantilever truss spans, 1,180 ft long and overhanging the standard opening, and 295 ft suspended spans between them, form the superstructure of the bridge which carries no less than five traffic lanes and two railway tracks, besides outside cycle tracks. The elevation of the bridge and a typical cross-section are shown in the two drawings.

The advantages of a bridge over a tunnel for the Channel are severalfold. It eliminates the ventilation problem and provides a direct crossing for road traffic. Few have ever thought that the tunnel could comprise more than twin bores for electric rolling stock, involving transfer of freight from road vehicle to truck at both ends of the tunnel or the extensive use of low trucks on to which road vehicles could be loaded. The bridge, on the other hand, can accommodate the largest vehicles on the road and it is immaterial whether the railways use electric stock or diesels to draw their trains. In these days, with road traffic growing as it is, any limitation on the use of road vehicles, as is imposed by the tunnel solution, may be fairly described as an anachronism.

The first cost of the tunnel is put at £100 million and of the bridge at £200 million. After a very detailed study, the Tunnel group know the revenue that they can reasonably expect and this figure is believed to be of the order of £18 to £20 million per annum. The sponsors of the bridge are putting their estimate of the traffic that the bridge would attract at £35 to £45 million a year. If the initial capital can be raised there would seem little to pick between the two as a business proposition, though there can be little doubt that the benefits to be had would be more widely spread with a bridge.

The shortcomings of the bridge, once it was built, are those of navigation of the shipping and the maintenance of the steelwork. The Channel is one of the heaviest used shipping lanes in the world and, even with modern navigational aids, it is not unknown for vessels to collide. The danger is not only one of a ship hitting a pier—protective booms could ensure that damage to neither ship nor pier need be significant—but of increasing the possibility of ships colliding in the restricted lanes that the bridge must impose. Painting of the bridge would be a mammoth task, though the steelwork would be nothing like that of the old Forth bridge.

The proposed line of the bridge crosses the Straights at its narrowest point, a distance of just 21 miles, from the South Foreland near Dover to a point close to Sangette near Calais. Rail connections exist within five miles on the French side and within two on the English side of the Channel. The cliffs on both sides are eminently well suited to the bridge approaches. In neither case would there be any difficulty in developing the terminal facilities for both ends of the bridge lie in open country.

The bridge has been designed to provide five lanes for road traffic on a highway 49 ft wide; two rail tracks, one on each side of the highway and built directly over the main trusses; and overhanging side tracks for cycle and motorcycle traffic. The design is such as to satisfy both French and British national loading standards and specifications.

On economic grounds—presumably the relative cost of piers to superstructure—the spacing of the piers has been put at 740 ft throughout the crossing except for two wider navigation openings situated on the sea routes either side of the Varne Bank. A minimum headroom of 170 ft at high water would be available under the ordinary spans and 230 ft in the two navigation openings.

With the proposed line of the bridge, the 142 piers would be distributed in varying depths of water at low tide as follows:—

Depth of water	Number of piers
0 to 65 ft	18
65 to 100 ft	35
100 to 130 ft	45
130 to 165 ft.	44

In addition, the piers would extend about 50 ft above low water level. The successive construction of this large number of piers, of similar design but in increasing depths of water, would enable a technique of fabrication and erection to be evolved as the work progressed towards the difficulties of the deeper water.

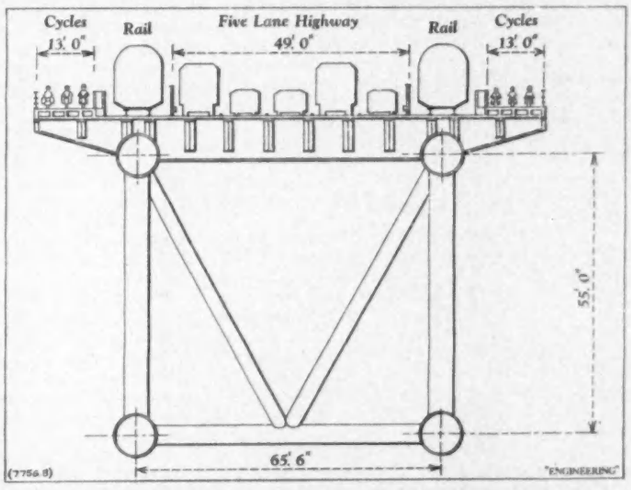
The piers have been designed roughly elliptical in form. They consist of heavy precast rings of reinforced concrete built one above the other with socket joints. A grouted rockfill mass poured into the bottom ring makes the foundation on the Channel bed. The remaining rings are to be filled with sand to obtain stability. Cables set in chases in the inside of the rings would anchor the piers to their bases. The piers are to be topped off with a concrete cap that would support the legs of the superstructure. Alternate piers are to have fixed and expansion bearings.

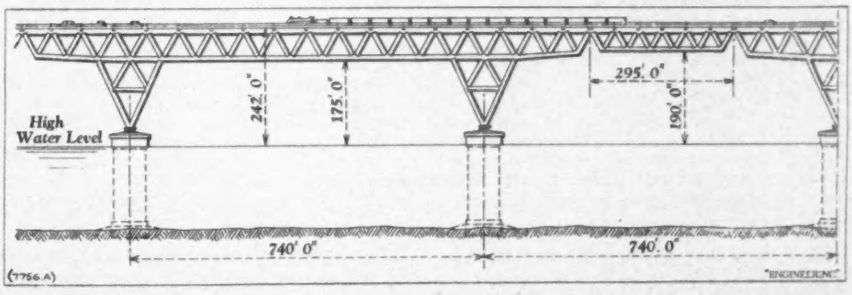
The main members of the bridge trusses are of tubular construction, made up from sheet steel by welding. The outside diameter proposed for the chord tubes is 11 ft 9 in and for the web members 6 ft 6 in. This is sufficient to give access for maintenance and to provide accommodation for services if required. Besides being economic of material, the tubular members possess the virtue of offering a minimum resistance to wind loading. The size of the project, combined with the volume of repetition, would ensure that an economic method of fabrication was evolved. Protection of the traffic against wind loading is to be obtained by so shaping the deck members as to deflect the wind currents. Wind tunnel experiments to this end are in hand.

It is proposed that the pier ring segments would be floated out from workyard basins on both sides of the Channel using "camels" or buoyancy tanks. At the site of each pier, De Long pontoons, carrying all the necessary erection equipment, would be used to place the segments. These pontoons can be floated from site to site but have retractable legs that can be forced down to the sea-bed so that the working platform of the pontoon is clear of the waves.

Complete spans of the bridge superstructure would be assembled in the workyards, rolled out on slipways on to pontoons for conveyance to the bridge site where they would be deposited on the completed piers by the falling tide, a technique that was used with marked success during the construction of the Auckland Harbour bridge by Dorman Long last year.

The total quantity of structural steelwork involved is about 800,000 tons.





(Right) The proposed bridge for the Channel would have a five-lane highway for road traffic, two rail tracks and overhanging lanes for cycles. The main members would be welded steel tubes having outside diameters of 11 ft 9 in for the chords or 6 ft 6 in for the cross-members.

(Below) The ordinary spans would be carried on piers at 740 ft centres. The main cantilever trusses are 1,180 ft long and the suspended spans 285 ft; the depth of the bridge is sharply accentuated at the piers to give a normal clearance over high water of 175 ft.

Granolithic Floors: A New Durable Mix

The correct design and construction of a concrete floor requires a firm base, "vertical joints" at all obstructions in the foundations and a well compacted topping to minimise shrinkage.

By F. J. Cosford, F.I.O.B., Managing Director, Bovis Limited

A common problem with which the management of industrial plants has to deal is that of maintaining granolithic floors in a safe, usable and reasonably dust-free condition. This all too frequently means constant, and at times, extensive repairs, with a correspondingly heavy annual maintenance bill.

Most of the difficulties experienced with granolithic floors can be appreciably reduced—if not eliminated entirely—if, at the time of laying, sufficient thought and the requisite supervision are given to the problem. The majority of general purpose factory floors consist of a concrete base with a granolithic wearing surface.

The cause and effect of the troubles usually met with can be included under the headings in the table.

A special technique is required where new surfaces are laid over old concrete, aiming to minimise the shrinkage, primarily by keeping down the water/cement ratio to avoid breaking the bond between the topping and the old concrete base.

The faults which have been referred to are associated with traditional methods of constructing floors. As a result of considerable experiment, methods have now been developed which not only eliminate the majority of these troubles, but do so at little or no extra cost, and under some conditions can even show a saving.

The basic principles on which these new techniques are founded are two-fold:—

(1) The reduction of the amount of water used in the mix for the concrete and granolithic to a point where there is just sufficient water to hydrate the cement.

(2) The complete compaction of the materials when in position to produce maximum density.

There are many factors to be taken into account in arriving at a formula for the construction of the perfect or near perfect floor. In the first place there is the foundation to be considered. Ideally, this should be of pitching, either stone or whole bricks, hand packed, and well rolled with a heavy roller, levelled off with a blinding-in layer of fine clinker. On clay soils a layer of coarse clinker is advisable before the hardcore is placed.

The bay layout of the floor should be planned to fit in with the module to which the factory is designed, and where appropriate, to suit the machinery layout, which means arranging the joints where possible to avoid trucking ways, at the same time arranging for the floor laying to be done on a chequerboard system so that the initial shrinkage of the concrete can take place before adjoining bays are laid. The foregoing precautions are intended to reduce the effect of concrets shrinkage to a minimum.

The strength of concrete is to a great extent related to the strength of the aggregate used. The larger the individual pieces of stone used, the denser and stronger, relevant to the amount of cement used, will be the concrete, always provided maximum density is achieved.

To obtain this, it is necessary for the mix to be scientifically designed, and to get the maximum advantage (structurally and economically) from the cement only sufficient water should be used to achieve complete hydration. With traditional methods of handling this would produce a "dry" concrete which would be much too harsh to work, but by using modern equipment, for example, power-driven vibrating rollers, maximum compaction is readily obtained. Using this method, the following advantages automatically accrue:

(i) The cement being utilised to its maximum advantage only the minimum quantity is needed. (Note: the strength of concrete is reduced by roughly 1,000 lb per sq. in for every additional gallon of water used per cwt of cement.)

(ii) Shrinkage, being largely related to the amount of water used, is reduced to a minimum.

(iii) Because of the low water content and a high density, a high compressive and tensile strength is obtained, permitting economies by reducing floor thicknesses and the weight of reinforcement required.

It is a fact that all structures settle to a greater or lesser degree. Settlement in itself is usually unimportant but unequal settlement is something to be avoided at all costs. Therefore, factory floors, particularly those which have to withstand variable conditions of super-loading, should be divorced entirely from all other construction. This is brought about by ensuring that no part of the floor bears, even indirectly, on foundations, bases, manholes and the like.

To achieve uniform support it is necessary to provide joints for "vertical" movement which should follow the outline of such foundations, and, of course, against perimeter walls.

To combat the conditions of unequal superloading, the joints between panels should have load transfer arrangements incorporated—dowels or joggles.—so eliminating the risk of "lipping."

The granolithic topping should have the same water/cement ratio as the base concrete and care must be taken to eliminate granite "flour," or dust, replacing it with sharp sand. An entirely different technique is required from that commonly used with traditional methods. In the first place the granolithic topping is placed in position as soon as each concrete floor bay is completed, it is then raked level, rolled flat with a garden roller, and finally finished with a power float.

The only occasion when a hand trowel is used is in the final operation, when it is necessary to close in the relatively few open patches left from the power float. The completed floor is then cured under wet sacking for a minimum period of seven or 14 days (according to climatic conditions) and finally a solution of silicate of magnesium is applied on each of three successive days in order to crystallise and bond to the floor any "free lime" that may be on the surface.

This method automatically secures the following advantages:

(1) The topping is permanently bonded to the base, and can be taken into account in the designed thickness of the floor.

(2) Maximum density is obtained with a corresponding increase in strength and durability.

(3) The mix is not displaced (as a result of the aggregate sinking and the cement paste rising) thus eliminating excessive surface laitence and the rapid wear and dusting this would cause.

(4) Surface tension is appreciably reduced, which eliminates all the defects which would otherwise result, i.e., saucering, crazing, and lifting.

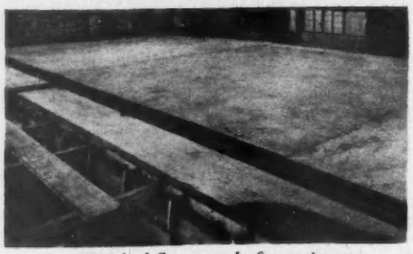
(5) Shrinkage is reduced to a minimum, thus avoiding trouble at the joints.

(6) There is no need for the excessive overtime or late shifts, with the increased costs that are necessary with traditional methods.

Ready for concreting

Hand rolling

Power screeding



Finished floor, ready for curing

Defects in Conventional Concrete Floors

	Effect	Cause
(A)	Cracking of the structural slab and lipping or riding of adjacent floor panels and the development of cracks around stanchion positions.	Unequal settlement of the floor due to inadequate preparation of the sub-grade, bad bay layout, and/or indifferent concrete and lack of load transfer arrangements between floor panels.
(B)	Cracking and/or crazing of the granolithic surface; saucering or lifting of the surface at the edges of the bays with cracking at the edges; excessive dusting; and excessive shrinkage causing the joints to open.	These are all due to the same basic fault, i.e. too much water in the mix for the granolithic and/or concrete.
(C)	Fracturing and disintegration at corners of panels where four corners of adjacent panels meet.	This is likely to be due to a bad floor bay layout. A staggered pattern should always be used to avoid four corners coinciding, which leads to excessive wear at these points, especially in trucking ways.
(D)	Fracturing and disintegration of surface where wide "expansion joints" occur between panels.	The wide so-called "expansion joint" creates more troubles than it aims to cure, and in practice is found to be quite unnecessary except in very special circumstances.
(E)	Hollowness through lack of bond between the granolithic and the structural slab.	Hollowness of the topping is most commonly experienced where the topping has been laid as a separate operation on a hard concrete base, and is due to the topping losing its bond with the base, which occurs when shrinkage takes place. In the case of new work, this method should be avoided at all costs and the topping laid monolithic with the base concrete.

Human Element

An Advisory Council on Management Education

The key question, " Who is going to teach management when the rewards of the successful manager are so high?", cropped up again at the Ministry of Education press conference on the new scheme for education in management.

It surprised no one that no clear answer was given.

There is nothing particularly secret about the methods and techniques of capable executives and for that reason the methods can be studied. But free time is not one of an executive's blessings and he is one of industry's least likely people to be able to carve time out of his week for part-time teaching.

The diploma envisaged in the new scheme, which is to take effect from September, 1961, can be worked for either in a year of full-time study or by three year's part-time effort. Entry to the courses is to be restricted to those who already have a university degree or the diploma in technology.

The contact at university between undergraduate and the professor who is actively engaged in research as well as in teaching is of unchallenged value. It is not easy to see how the full benefit of management education can be given to the students unless practising industrial managers can be induced to take to regular lecturing, perhaps on a one-day a week basis. That is by no means the same thing as a high powered talk from a visiting press officer.

The new United Kingdom Advisory Council on Education for Management is expected to be broadly based. The Ministry of Education, and the British Institute of Management who have worked closely with them, hope to see leaders from management, from teaching, industrialists and senior members of professional bodies, both engineering and scientific, joining the advisory council.

Mountaineering as a Steel Works Safety Aid

The latest safety film of the British Iron and Steel Federation resulted in the design of a new rescue stretcher for use in mountain areas.

This is not so off-beat as it sounds. The film, " Hazard " has at first viewing nothing to do with steel works or safety rules and regulations.

But it has everything to do with moving up and down at dangerous heights. Shot in the Italian Dolomites using expert mountaineers, and written and directed by Tom Stobart, the Everest expedition photographer, the film recounts, in full colour, a difficult ascent undertaken by two steel workers.

There is an obvious problem in introducing the paramount need for operatives to move with constant regard for steel works safety rules to new recruits to the industry. At the same time they must not be put off the subject by too swift confrontation with detailed instructions.

Hazard, which instead goes directly to the heart of the safety problem should grip its viewers with suspense and keep them happy with the mountain scenery while putting over its message that moving with regard to safety is a perfectly professional thing to do.

While Hazard has an entertainment value able to put it into many commercial cinema programmes it carries at least two noteworthy asides. Steelworkers rockclimbing in Italy? This is a thought which would have staggered British holidaymakers abroad not so long ago. And, after all, the film was made for the steel industry. Pitons, it is pointed out, are the steel spikes on which every advanced climber's life depends.

The stretcher? While the film team was staging the recovery of a climber from an accident the stretcher to which he was roped tore on a rock. It needed all the ingenuity of the guides to carry out a real-life rescue.

And a stretcher less likely to tear was then designed.

Live and Let Live at 3 a.m.

Hazard will in the main be seen during fairly normal hours. Putting safety on film over to dock workers calls for some rather different timing.

In Aberdeen the safety film, Live and Let Live, made by union-employer cooperation in the dock industry, was shown to night shift dockers at 3.20 a.m.

The National Dock Labour Board has a mobile cine-van which gets the films to the workers, the only way they are going to be seen in an industry like the docks where men are spread out along miles of wharves.

While more than three out of four dockers in some British ports have already seen the film showing is going steadily forward. Copies of the film have been bought by overseas authorities including the Australian Tonnage Committee and the Greek Port Piraeus Authority. The War Office has purchased copies for its Port Operation Group and other transport units.

Engineers with Influence

Mr. Reginald Maudling, the President of the Board of Trade, was warmly received by scholars of the Federation of British Industries at their recent reunion dinner. He pointed out that the contribution of engineers in turning the idea into something that could be bought and used tended to be overlooked in this country and abroad.

Since October, 1950, promising young engineers have been coming to Britain and training at industrial establishments from Babtie, Shaw and Morton, of Glasgow, to British Insulated Callender's Cables, in Kent, and from Stothert and Pitt, of Bath, to Marconi, at Chelmsford.

So far, 357 young men have benefited from the scheme, just under half of them from the Commonwealth. More than 200 have come from Latin America and from Asia, Europe and non-Commonwealth Africa. Already may of the Federation's scholars have reached positions in their own countries where they are able to influence overseas trading decisions.

One of the characteristics of the countries from which the scholars are drawn is that all are countries at an early stage of their development. An engineer who might expect four or five years after graduation to be in the lower ranks of responsibility in this country may well find himself directing important plant and facilities in States whose lack of equipment is only matched by the scarcity of qualified engineers.

The Federation's scheme has obvious advantages in setting up useful links while at the same time helping on advances abroad.

But there is not much room for sentiment. One young engineer soon to return to his own country from Associated Electrical Industries, remarked to ENGINEERING's representative: " Of course we are interested in your equipment, if the price is right."

An Extraordinary Group of Engineering Leaders

Back in 1943, while the war was raging round the Mediterranean and Bomber Command was building up its bombardment of Germany, the Bristol Aeroplane Company had a brilliant group of engineers specialising on research programmes. They were known as the Project Stress Office.

The group worked, among other things, on the initial structural design of the Brabazon I. It had four founder members, Hemp, Laight, Farrar and Strang.

The subsequent careers of all four have been outstanding. Mr. W. S. Hemp is now head of the department of Aircraft Design and Professor of Aircraft Structures and Aero-Elesticity at the College of Aeronautics. Mr. Barry Laight has become chief designer of Blackburn and General Aircraft, Mr. D. J. Farrar last month became Bristol's chief engineer (guided weapons), and Dr. W. J. Strang the company's chief engineer (aircraft).

Mr. Farrar has been responsible for the coordination, design and development of the Bristol/Ferranti Bloodhound guided weapon system. Educated at Sutton County School, Surrey, Mr. Farrar won the John Bernard Seely prize in aeronautics and the Archibald Denny prize in structures when he was at Gonville and Caius College, Cambridge.

Dr. W. J. Strang joined Bristol's from Torquay Grammar School in 1939. Setting a record by taking first place in four subjects in the Associate Fellowship examination of the Royal Aeronautical Society, he transferred to the stress office and worked on the Beaufort, Buckingham and Beaufighter aircraft.

Leaving Bristol's in 1946, their future chief aircraft engineer took up scholarships at Kings College, London, taking First Class Special Honours in mathematics in 1947. While working at the Melbourne, Australia, Aeronautical Research Laboratory he took his Ph.D. in 1950 with a thesis on " A Physical Theory of Supersonic Aerofoils in Unsteady Flow."

A year later he rejoined Bristols as deputy head of the guided weapons department.

Health through Work Project

Industrial Therapy Organisation (Bristol) is a new company which has started administering a local factory staffed by mental patients who were formerly without useful occupation.

The scheme has developed from the pioneering efforts of Fishponds Hospital, Bristol, who two years ago combined with the Tallon company to give their patients useful work, in that case assembling ball-point pen parts.

Industrial Therapy Organisation has a diverse board made up of Bristol industrialists, trade union representatives, medical men, and church and civic figures, all serving without fees. The chairman is Sir William Grant, chairman of the West of England engineering and allied employers' association.

Three firms are cooperating in the enterprise. They are Tallon, E. S. and A. Robinson, and Brecknell, Dolman and Rogers. The first plans for production from the ITO factory are for packaging for consumer goods and for other suitable products including ball point pens.

A Broader Measure for Office Conditions

The Offices Bill, passing through the parliamentary stages 14 years after the appointment of the Gowers Committee to look into health, welfare and safety in non-industrial employment, may have only a short life.

Mr. R. A. Butler, the Home Secretary, received representatives from the Trades Union Congress earlier last month and the TUC men left the meeting with a strong feeling that legislation amplifying the provisions of the Offices Bill can be expected possibly in the lifetime of this parliament. If that seems to be setting a leisurely pace for their expectations it is not as slow as movement towards the creation of some enforcement powers for conditions of office employment as has been since Sir Ernest Gowers first presided over his committee.

One of the lost opportunities in this situation is that vast acreages of office buildings have sprung up in the period that nothing was being effectively done to carry through the Gowers recommendations. It is by no means true that poor lighting conditions, unsatisfactory washing facilities and simple overcrowding are confined to old premises.

At Least 66 Casualties Saved by the M1

Mr. Ernest Marples, the Minister of Transport, has been driving on the London to Birmingham M1 and studying the police reports on its first three months use.

One of the most interesting facts that emerges from the police reports is that in the first months of M1's useful life, the casualties on the Motorway, A5 and A45 were 183. On A5 and A45 in the same three months of 1958-59 the casualties numbered 249.

Mr. Marples said that the experiments with anti-dazzle screens will go on and that the mistake of drivers entering maintenance area slip roads should end when " Maintenance Unit Only " signs are put up soon.

Important safety tips that drivers should remember are to cut down speed when leaving either end of the special road.

Slip roads should be entered smoothly and with proper warning. Drivers leaving at the last moment cause following traffic to brake suddenly and perhaps cause " concertina crashes."

Engineering Growth in the North East of England

Continuing his visits to the main production centres of the United Kingdom, Mr. Novy finds energy and enterprise in the North East. Local men study local problems relentlessly and skilfully.

By H. J. Novy

The first of this series of first-hand reports was on Clydeside (ENGNG., 1 Apr., 60, p. 446). The third, in next week's issue, will be on Northern Ireland.

When I visited the North East of England to meet leaders of its industries, commerce and education, I fully expected to hear a reiteration of the difficulties I had heard on the Clyde. The situation looked similar in basic essentials: unemployment stands at 4 per cent, the third highest among Britain's main industrial centres after Clydeside and Merseyside. The same heavy industries seem to predominate: iron castings, steel plate and structural sections, and the users of these products. The industrial roots could hardly be more similar to those of the industries of the Clyde and South Wales, and there was ample evidence that the exhaustion of natural resources, the emergence of oil as a competitor to coal on a world scale, the move away from steam power to electrical power and the slow erosion of the region's basic industries militated heavily against a renewed bout of expansion. Shipping has suffered from depressed freight rates; shipbuilding and ship repairing are in an anxious mood.

Yet the story I was told was on the whole a cheerful one. The whole weight of emphasis is placed on potential, on growth and on new ventures. There is pride in the achievements of the past two decades and confidence that they can be continued and improved upon. No matter to whom I talked—light engineers on the Team Valley Estate, research workers at Durham University, heavy engineers and shipbuilders on Wearside, or Conservancy Commissioners on the Tees—the lasting impression was one of optimism. Typical of this attitude is the recent ammouncement in the Press that extensive measures would shortly be taken to clean up the region's river. Other evidence is provided by the building activity which goes on in Newcastle, Gateshead and other main towns. Tall, modern blocks of flats are rising above the blackened landscape of slum dwellings and stockyards. New offices, new shops and—more important—new roads point to a new lease of life for the region.

At the same time the problems of the area must not be overlooked. During the inter-war period there was a large and continuing movement of labour from the North East, mainly to London, the South East and the Midlands, and migration still goes on, at a rate exceeding 10,000 a year.

The table shows the structure of industry in the North East and the changes that have taken place in the economy since the war. It is based on statistics of insured persons, collated by the Ministry of Labour and published by the North East Industrial and Development Association (NEIDA) in their analysis of regional statistics entitled "The Northern Region."

At mid-1955, 34 per cent of the North East's insured workers were employed by the older basic industries shown in the table, which include iron ore mining, coke oven works, constructional engineering and general engineering. There has been a considerable increase in the numbers employed in both the latter categories: from 7,600 to 11,400 in constructional engineering and from 55,600 to 74,200 in general engineering. This group, which is a very broad one, contains industries which are basic to the North East, such as the building of railway locomotives, the manufacture of boilers, iron and steel castings, ship's deck machinery, coal machinery and several other old-established sections of the heavy engineering industry. Some industries in the group, however, are new—such as mobile cranes and excavators, printing machinery, and a large number of other products which came to the North East mainly during or after the war, attracted by the excellent facilities provided for light and medium engineering concerns on the area's industrial estates.

Another "new" industry, which is perhaps better described as a deviation from traditional products and uses to the full the skills and aptitudes the workers in the area have acquired over generations of heavy engineering, is that which produces the wide range of plant and machinery required by the chemical, petroleum and atomic energy industries.

Despite the obvious importance of such developments, the most significant feature emerging from the table is that coalmining has declined both relatively and absolutely while still remaining the region's largest single industry. Average employment during 1958 was 157,000—20,000 less than 20 years previously.

Although employment in shipbuilding has remained high, the number of workers attached to marine engineering has declined compared with pre-war. On the other hand, employment in the other older basic industries, particularly iron and steel, has increased both relatively and absolutely. Employment in the older basic industries is now substantially higher than before the war; their vulnerability to fluctuation in demand, which generally includes export demand, is traditionally high.

Although employment in the older basic industries has risen over the past 20 years and remains currently between 5 and 10 per cent above the pre-war level, and although productivity in some of these industries has greatly improved, it is in the newer industries that the best performance has been achieved.

With the exception of vehicles, all the newer industry groups expanded more, or declined less, in the North East than in Britain as a whole. The chemical and electrical machinery industries, which provided the major growth in the region's economy between the wars, have continued to forge ahead. Employment in the chemicals and allied trades, which before the war totalled 18,500 people in the North East, had increased to 52,000 in 1958. The growth of electrical engineering is even more striking, the corresponding employment figures being 9,100 and 16,700 for electrical machinery, and 755 and 19,600 for electrical goods.

MORE WORKERS

The general picture provided by employment statistics indicates that the region has expanded its labour force by about 25 per cent since 1938 and its output by a substantially greater margin due to the adoption of improved methods. of production.

Some indication of the intensive developments that have taken place since the war in the North East is given by the statistics of new factories and extensions (over 5,000 sq. ft) carried out by manufacturing industry from 1945 to 1958. In those 14 years 33½ million sq. ft of new factory space has been built. This is more than in any other "development area" and compares not unfavourably with the two regions in which major growth has taken place: the Midlands where 55 million sq. ft have been added and the London and South Eastern industrial region which comes next with 52½ million sq. ft.

During my visit I was told frequently that the vitality of the region and its industrial stability depended to a great extent on how far the authorities, local and national, were successful in promoting a diversified economy. I found that in most cases, however, what they meant was the promotion of industry with a good potential for expansion. On the subject of diversification I found myself in complete agreement with the authors of NEIDA's report on development area policy: "The plea for considerable diversification . . . underestimates the advantages to be gained by a high degree of industrial specialisation within a region and also seems to ignore the fact that for any industry there may be significant differences in relative regional costs. The natural advantages of any particular area are often greater for one type of industry than for another. Moreover, localisation of an industry brings acquired advantages. Among these may be cited the attraction of ancillary trades, including those engaged in the servicing and repair of specialised machinery, the creation of a high level of relevant skill among local labour, and the build-up of technical education, research facilities and professional and commercial services closely geared to the needs of the industry. Finally, not least among the advantages of localisation is the fact that it facilitates easy and rapid contacts between firms engaged in similar and successive stages of production. These factors help to reduce costs and thus accelerate the growth of an industry." Billingham is now the largest chemical factory in the Commonwealth and five ICI Divisions have works there. The new Heavy Organic Chemicals Division's main product, high purity ethylene, is the raw material for a wide range of organic products. The growth in demand since the war has been tremendous, particularly for "Alkathene", ICI's brand of polythene, and "Terylene" polyester fibre.

Billingham currently produces, on a 1,100 acre site, one million tons of fertilisers a year and one million tons of other products many of which are supplied to ICI's Wilton site on the other side of the Tees. One million tons of anhydrite is mined every year and 1·7 million tons of coal consumed. £163 million have been invested on the site and 18,000 people are employed there.

At I.C.I's Wilton, site, on the south bank of the Tees, linked to Billingham by pipelines running in a tunnel, two thousand acres have been acquired, 600 of which have now been developed. Capital expenditure at the end of last year had exceeded £100 million and the personnel employed totalled nearly 12,000, some 75 per cent of whom are concerned with the operation and maintenance of plants and the remainder on design and construction. Capital expenditure continues at the rate of nearly £1 million a month.

When developments on this large scale take place, complementary growth is promoted in the whole region. The demand for water (acute last summer when several plants in the area were threatened with closure) led to plans formulated

by the Tees Valley and Cleveland Water Board which will raise the reliable water yield of the undertaking from 19½ million gallons to 65 million gallons a day.

Another consequential development on Tees-side has been the construction of oil terminal installations at Teesport, which is one of the largest and most up-to-date ocean installations, with 32 million gallons of storage facilities. It was opened in 1957 and since then extensions have been made and additional land acquired for further expansion. Shell Mex and B.P., who operate the oil installatons at Teesport, are currently engaged in the development and reconstruction of ocean oil installations at Jarrow where they are spending £1 million. Esso Petroleum are constructing a new marine terminal at Tynemouth, which will take two years to complete and cost some £2 million. The next step could well be the construction of a refinery on Tees-side, which could supply ethylene to Wilton and Billingham, as Esso Petroleum have undertaken to do to ICI's new works on Severnside near Avonmouth.

Many other chemical and plastics firms have settled in the region during the past two decades, and particularly since the war when considerable expansion has taken place. Employment by the industry totals 52,000 of whom about 30,000 are employed at Billingham and Wilton and the remainder by a large number of other firms.

The importance of iron and steel to the North East coat has already been stressed. To Tees-side it is even more so, accounting for almost a fifth of the total number of insured persons in the area compared with some 5 per cent for the North East region as a whole.

Dorman Long and Company have now virtually completed a programme of expansion costing £60 million, of which the main item was the construction of the universal beam mill at Lackenby. Some of the new mill's products are already finding a market in North America.

The South Durham Steel and Iron Company have built additional coke ovens, a sinter plant, two new blast furnaces and additional steel-making capacity at West Hartlepool, reconstructed their Cargo Fleet works and have planned a new integrated steel works at West Hartlepool to be built at a cost of £40 million. The Consett Iron Company intend to build a new steel plant and plate mill, at a cost of £28 million, using the oxygen blowing process. Altogether these plans add up to a combined capacity of 6 million ingot tons of steel a year for the North East region, a fifth or more of the country's total planned capacity for 1961.

The heavy engineering industry of the region, which grew up around the production of steam locomotives, boilers, ships' machinery, coal-mining machinery and large electrical machines, has encountered many problems in the task of adapting itself to technical changes in the demand for its products. Perhaps the most striking development has been the establishment of a large nucleus of firms producing heat exchangers, pressure vessels and a wide range of plant and machinery for the process industries and for the generation of nuclear energy.

On Tees-side, Head Wrightson and Ashmore, Benson, Pease and Company (the Power Gas Group) have spent several millions on building vast new works. On the Tyne, Clarke, Chapman and Company, Reyrolles, and C. A. Parsons have equipped themselves with the plant and research facilities to engineer and build atomic power stations. These three firms have pooled their resources, together with five others including Whessoe of Darlington and Head Wrightson, in the Nuclear Power Plant Company, to build the country's first commercial atomic power station at Bradwell in Essex. N.P.P.C. are collaborating with Agip Nucleare of Milan in the construction of nuclear power stations in Italy. They are also co-operating with Swan, Hunter and Wigham Richardson, the Tyne shipbuilders, in the development and building of nuclear-powered ships.

There is further evidence of technical eminence in heavy engineering. PAMETRADA (The Parsons and Marine Engineering Turbine Research and Development Association) have made considerable headway in the development of marine gas-turbines and are the leading British designers of marine steam turbines. Smith's Docks, South Bank, were the first shipbuilding firm in Britain to develop the free-piston gasifier engine into a satisfactory and promising marine propulsion engine. At Sunderland, Steels Engineering Products, a subsidiary of Steel and Company, have become the leading manufacturers of mobile diesel-electric cranes in this country and probably in the world, doing business successfully in Germany, the USA, and Japan. The timber importers and saw millers of the North East have pioneered the manufacture of plywood and blockboard and are prominent in the treatment and processing of timber. On the Team Valley Estate, Sigmund Pumps, who are makers of the largest types of industrial and process pumps, have pioneered the small hot water circulator for domestic central heating and played a leading part in the adoption of small-bore central heating in this country.

SHIPBUILDING

The shipbuilding yards of the North East accounted last year for 49 per cent of the total launchings from UK yards. Their order position is far from good but there is relatively little surplus capacity so far.

Considerable strides have been made in the modernisation of shipyards and the time required to build ships has been cut down radically. The Bamburgh Castle, an ore carrier of 16,700 tons built by Swan Hunter, took only seven months from keel laying to launching. A Wearside shipyard, Bartram and Sons, launched a 10,000 d.w. tons cargo vessel in 11 weeks from the laying of the keel. Improved techniques of prefabrication enabled another Wearside yard, that of Joseph Thompson and Sons, to launch a bulk carrier of 15,000 tons in 10 weeks which included the Easter and Whitsuntide holidays.

North East shipbuilders have also shown foresight in assessing the trend towards tankers of very large size. Much of the modernisation programme has been carried out with this in view, and facilities are now available and more are planned for dealing with these large ships. Perhaps the greatest change has been seen on the Wear. It is claimed that the river can now launch vessels up to 65,000 tons d.w.; only a few years ago the biggest vessel launched was around 15,000 tons.

There is no mistaking the vigour and enterprise of the region's shipbuilders. They will certainly not fall in readily with schemes for reducing capacity.

Perhaps the most striking evidence of this will is the construction of new wharfs, dry docks and other facilities for shipping and ship repairing. The Tees Commissioners are spending over £3 million on a new five-berth dock with unrestricted and modern road and rail access. This is in addition to the expenditure of £1 million by Shell Mex and BP on an oil distribution depot and ship bunkering facilities, £½ million by the British Transport Commission on modernising quays in the Middlesbrough dock and nearly £10 million on the extension of their marshalling yards and sheds. The Tyne Commissioners have given permission for the construction of two new dry docks. One of these, planned for the Palmers Hebburn yard of Vickers Armstrongs, is to be capable of taking tankers of 80,000 tons d.w. and suitable for extension later to take ships of 100,000 tons.

The building of industrial estates, which began in May, 1936, has played a most important part in the promotion of light industry in the North East.

Total employment in existing premises on the industrial estates at the end of last year exceeded 58,000 and was rising. The recession which followed the Government's policy of restraint during 1957 and 1958 caused a fall in activity and the suspension of new projects. Work scheduled to be carried out or started last year, however, amounted to £2½ million. The firms for whom extensions are being constructed are engaged in such widely diverse industries as clothing, carpets, printing and packaging, electrical goods, paints, plastics, hosiery, scientific instruments, furniture, musical instruments, and many types of engineering. When completed it is expected that 3,000 new jobs will have been provided by the 1959 building programme of North Eastern Trading Estates Limited.

This brief examination of the industrial affairs of the North East has provided strong evidence that the region is capable of more than holding its own both in the older basic industries and the newer ones.

In conclusion I can do no better than quote from the report of NEIDA on the subject of the industries which research has shown to be the best suited for the region. Having selected electrical goods, engineering and chemical trades, the authors comment as follows:

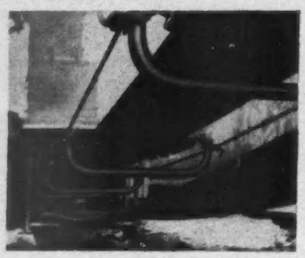
> All are growing industries which seem destined to play an increasingly important part in Britain's economic future. Moreover, all of these industries, and many of the firms within them, have a diversity of products and outlets, which would seem to promise a greater degree of stability in small economic upsets than do most of the older traditional trades of the North East. We believe that if these newer expanding industries and their ancillary services could be further built up in the region, the North East would achieve the best of both worlds—diversity within specialisation.

TABLE I *Changes in Industrial Population in the North-East Region*, 1938-57

Industry Groups	Index of Changes in Numbers in Various Industry Groups				Percentage Distribution of Industrial Population between Industrial Groups				Numbers insured
	1938	1946	1949	1957	1938	1946	1949	1957	1957
Older Basic Industries									
Coalmining	100	84·7	89·3	91·5	18·1	14·3	15·4	14·7	161,472
Iron and steel	100	102·8	113·0	132·0	3·5	3·4	3·8	4·0	44,091
Shipbuilding and repairing	100	133·0	119·7	122·0	4·1	5·0	4·7	4·4	47,598
Marine engineering	100	116·6	109·5	107·8	1·8	2·0	1·9	1·7	18,174
All other	100	129·2	115·7	129·2	7·7	9·3	8·4	8·5	93,298
Total	100	103·2	101·8	108·8	35·2	34·0	34·2	33·3	364,633
Newer Basic Industries									
Chemicals	100	155·1	168·8	258·0	1·5	2·3	2·5	3·3	36,649
Electrical machinery	100	130·4	141·7	185·5	0·9	1·1	1·3	1·5	16,686
Total	100	145·3	158·0	243·0	2·4	3·4	3·8	4·8	53,335
Other Extractive and Manufacturing Industries									
Chemical and allied trades	100	233·8	132·3	140·0	0·5	1·0	0·7	0·6	6,597
Electrical goods	100	493·9	1,164·4	2,600·0	0·1	0·4	0·9	1·8	19,627
Textiles	100	118·9	151·3	256·5	0·5	0·6	0·7	1·0	11,203
Clothing	100	176·1	196·8	248·0	1·2	1·9	2·2	2·5	26,811
Food, drink and tobacco	100	113·1	124·0	151·5	2·2	2·3	2·7	2·9	32,286
All other	100	104·1	115·1	130·0	5·9	5·9	6·3	6·8	73,987
Total	100	123·7	136·4	129·5	10·4	12·1	13·5	15·6	166,057
All Other Industries	100	103·5	97·1	129·5	52·0	50·5	48·5	46·3	507,101
Grand Total	100	106·8	104·7	129·0	100·0	100·0	100·0	100·0	1,095,580

ROPE CONVEYOR

Quick Assembly



THE Limberope conveyor system uses standard Limberoller idlers strung from rope side supports.

Chief claims for the arrangement are that it is quick to install and remove, and that it can follow the contours of the ground better than other arrangements. Only a low tension is required in the rope between anchor points.

The flexible Limberollers are mounted on rigid tubular steel cradles which in turn are suspended from parallel wire ropes. These stringers are held at the required height by adjustable chains attached to stands, which also carry integral return idlers for the belt. Quick release hand bolts on the cradles are used to clamp them to the rope stringers.

The design allows idlers to be set at intervals from 4 to 9 ft and stands from 12 to 40 ft apart. Materials with densities up to 150 lb per cu. ft can be handled. The system can accommodate belt widths from 16 in to 36 in, the wire rope diameter varying from $\frac{1}{2}$ in to $\frac{3}{4}$ in. to correspond. On outdoor installations the conveyor can span gullies without the need for elaborate support structures. On underground mining installations the conveyor can keep pace with advancing faces.

It is stated that the belt life is long because there is no pinching and the flexible idlers give a "cushioned" ride. The troughing catenary exerts a self centring action on the material carried, largely preventing spillage. No maintenance is another claim; the idlers are carried on two bearings only and these are the self lubricating "sealed for life" type situated well above the dirt zone. *Joy-Sullivan Limited, Cappielow, Greenock.*

5 CU. YD DUMPER

4 × 4 Drive

FRONT and rear axles are both driven in a new version of the Abelson 5 cu. yd dumper.

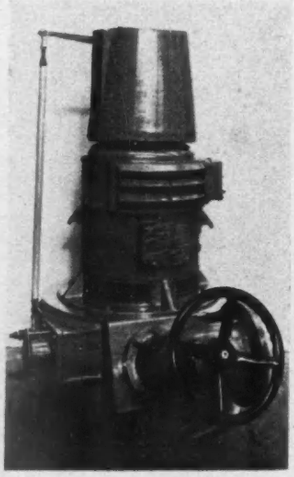
The vehicle is described as a "struck cap steel bodied scow ended diesel dumper" and is designed for off-the-road use, coupled with lightness and ease of discharge. A 60° angle of tip is obtained by the 15 ton capacity heavy duty twin rams. The body will take 4½ cu. yd struck and an 8 tons payload when operating with the 4 × 2 (rear axle only) drive. Front and rear towing jaws are provided. The floor sandwich in the standard body is 2 in thick; a saw tooth floor is offered as an alternative.

The fuel tanks are placed on top of the channel immediately behind the driver's cab and the vehicle batteries are behind the passengers' seat in the cab. Overall width is 7 ft 6 in and track is 5 ft 5¼ in; wheel centres are at 11 ft 4 in and overall length is 20 ft 6 in. Overall height unladen and on 9·00 by 20 tyres is 9 ft 10 in. If desired, the tail of the body can be reinforced with 2½ by 2½ in angles. A 6 in spill board is fitted.

The vehicle can be driven with either front and rear axle drive or with rear axle alone. The tyres normally fitted are 9·00 by 20 12 ply road track majors. *Abelson and Company (Engineers) Limited, Coventry Road, Sheldon, Birmingham, 26.*

HYDRO-ELECTRIC GENERATOR

Heads from 90 to 300 ft



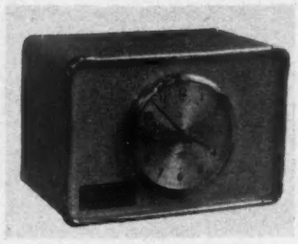
A RANGE of small standard hydro-electric generators has been developed.

The units are designed for the production of power in remote areas, and models cover the range from 5 to 25 kW. They are suitable for heads from 90 to 300 ft. Speed is governed so that electricity is produced at standard frequency and the units can therefore be used to operate normal domestic agricultural and small industrial equipment. The alternator is of Stamford design with static excitation and regulation. Voltage regulation is close at all lagging power factors and alternators for 50 and 60 cycles can be supplied for voltages up to 550, single or three phase.

The turbine is a Turgo impulse wheel overhung on the lower shaft extension of the alternator. Water supply is regulated by a spear valve of normal design which obviates the need for an inlet valve if the line is short. Speed control is by jet deflector. Only the simplest foundations are required for the units, which are suitable for use at altitudes up to 10,000 ft and in tropical conditions. *Gilbert Gilkes and Gordon Limited, Kendal, Westmorland.*

PULSE SOURCE

Extreme Accuracy



AN electronic pulse source with an accuracy of a few seconds per annum is now being made commercially. In cost and performance it falls between the conventional instruments and the caesium clock.

The ATE crystal chronometer employs a crystal controlled oscillator to generate a basic frequency which is fed to a series of binary dividers. The outputs of these are fed to separate pulsing relay circuits to produce pulses at the required intervals. The circuits are completely transistorised and make extensive use of printed circuit plug-in panels.

The standard instrument produces square wave pulses at intervals of 1, 30 and 60 seconds, but other rates can be provided. For example, 50 per second for generator synchronising or a 20 millisecond marker for electro-cardiographic work. Frequency stability is achieved by operating the crystal over a particular part of its characteristic. A thermally compensated crystal oscillator can be included for use where temperature changes are large. No extra power is needed to run this compensator. It allows for a greater fluctuation in temperature for a given accuracy than systems using heaters or thermostats or gives an improved accuracy where temperature variations are small.

The accuracy of the chronometer is not affected by vibration or movement and the instrument can therefore be installed in any vehicle. Standard models operate on a 24V d.c. supply, but others can be produced. The casing is anodised aluminium and measures 12 in by 8¾ in by 7⅛ in. *Communications Systems Limited, Norfolk House, Norfolk Street, London, WC2.*

POWER METER

Checking Audio Oscillators

TYPE 610C output power meter is a transistorised instrument for measuring the output of audio oscillators, amplifiers and networks.

The instrument can also be used to determine directly the source impedance of equipment operating in the range from 10 c/s to 50 kc/s. The output is measured by providing between the input terminals of the instrument a resistive load of high-power wire-wound resistors for the equipment under test. Forty values of resistance over the range from 2·5 ohm to 20 kilohm can be switched in by rotary switches. The voltage across the selected resistor forms the input of the transistor amplifier which drives the meter circuit. A variable attenuator ganged to the selector switch allows direct readings from 0·1 MW to 10W in four ranges.

The accuracy is unaffected by a direct current imposed on the load signal. It is ± 0·5 db on the × 1, × 10 and × 100 impedance ranges and ± 1 db on the × 1,000 range. Source impedance is found by adjusting the load to draw the maximum power from the source. Accuracy is ± 2 per cent from 20 kilohm to 20 ohm, and ± 5 per cent plus 0·25 ohm below that. Operation is by dry batteries or mains. The weight is about 7¼ lb. *Dawe Instruments Limited, 99 Uxbridge Road, London, W5.*

VISCOSITY CONTROLLER

2 per cent Accuracy

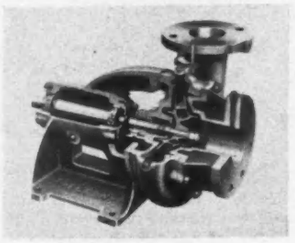
A NEW viscosity controller uses a standard sample to obtain an accuracy of ± 2 per cent on continuous running pipelines.

The controller was designed primarily for use in refineries for blending cuts to a set viscosity. The response time is 25 seconds and control is by opening or closing one of the pipeline valves. The instrument is flameproof and needs no attention.

Oil from a standard sample drips by gravity through a strainer to a rotating cup viscometer, the output drag being transmitted to a balance arm. Oil from the pipeline, is metered by a pump through a second drag viscometer and the output torque is fed to the other end of the balance arm. Thus any difference in the viscosities is transformed into a difference in torque and the balance arm is displaced, operating a pair of micro-switches. For pneumatic systems these can be replaced by air valves. The viscometers are enclosed in a constant temperature water bath and 1 pint of the standard oil is sufficient for a day's operation. *Smiths Industrial Instrument Division, Chronos Works, North Circular Road, London, NW2.*

CENTRIFUGAL PUMP

High Efficiency



THE new range of Sultan centrifugal pumps includes sizes from 1½ in bore to 12 in.

There are 42 models in the range but the design is such that only 254 different parts are required. Interchangeability of parts is therefore high. Outputs range from 20 to 3,500 gallons per minute. Powers required are from ¼ h.p. to 75 h.p.

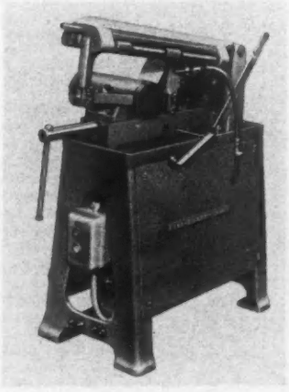
The pumps are vertically split end suction single stage centrifugal types, designed to run at speeds up to 2,900 r.p.m. at which speed total heads of about 275 ft can be used. Full capacity can be obtained with a suction lift of 15 ft; with a reduced capacity, lifts of 25 ft can be achieved. The pumps are available in three basic forms for various types of drive. That illustrated is for long coupling; with a pulley on the end a similar version is for belt drive; while for close coupling the outer bearing is dispensed with and the pump flange mounted on the motor.

The pump casing is cast iron and the outlet can be set in any one of four positions. The suction cover is spigot fitted with an asbestos based fibre sealing gasket. Gauge tappings are provided. The impeller is of high grade cast iron with smooth finished blades and shrouds. The vanes are designed to produce a stable head capacity characteristic.

Four interchangeable scales are available. A carbon Stellite mechanical seal is fitted as standard for general use in temperatures up to 200° F; alternatively, mechanical seals by Flexibox or Crane can be used where higher temperatures or corrosive liquids are to be handled. A stuffing box can also be used. *Pegson Limited, Coalville, Leicester.*

POWER HACKSAW

Hydraulic Relief



A NEW Braunstone power hacksaw has a capacity for 4 in diameter round material on a 90° cut.

The machine is designed for use where its small size and portability are an advantage. It need not be bolted down to the floor. The adjustable hydraulic relief mechanism that is fitted to the blade increases efficiency and gives an advantage when cutting thin walled tube. The blade makes 150 strokes per minute and cuts on the back stroke. The relief comes into operation on the forward stroke. The standard motor is rated at ¼ h.p. 400/440V three-phase 50 cycles and runs at 950 r.p.m. The blade is 12 in long of heavy duty type with 10 pitch teeth.

Adjustment of the hydraulic relief is by a knurled screw at the front of the oil tank; unscrewing it will give rapid lowering of the arm. The saw frame runs in Oilite bushes which are situated on the frame itself to give maximum rigidity while cutting. The drive is by double reduction V belts and both the motor and the countershaft bracket are adjustable on slide rails. Floor space required is 2 ft 6 in by 1 ft 6 in and the weight of the machine on its stand is 2¼ cwt. A suds pump and tank with filter can be fitted if required. *A. A. Jones and Shipman Limited, Narborough Road South, Leicester.*

TAPE RECORDER

Facsimile Transmissions

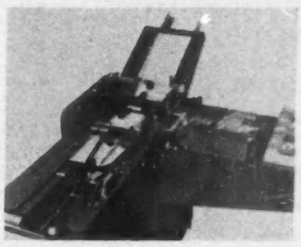
SERIES D-944 tape recorders are designed for use in relay stations handling facsimile transmissions.

The instruments are intended to receive and hold information until such time as it can be retransmitted, and also as a record for checking and repeat transmissions. The equipment takes the form of a self-contained console. The tape deck is mounted horizontally at a convenient operating height and protected by a transparent lid. Controls are on a sloping panel and the chassis units are easily accessible.

There are two types: one for storage of picture signals and the other for storage of weather chart and document signals which are normally reproduced by a direct recording process. The latter type are for automatic operation, starting on receipt of a special signal from the transmitter and reverting to standby on completion. The tape speed is controlled by recording a standard 1,000 c/s signal with the original information and checking it against the standard during replay. Any phase error is used to correct the speed so that any tape stretch is nullified. *Muirhead and Company Limited, Beckenham, Kent.*

ENVELOPE FILLER

Mailing Publications



THE Inserta model M3000 is a machine designed to place catalogues, manuals or magazines in envelopes ready for mailing.

The machine is fully automatic in operation. The envelopes are fed one at a time from the stack in which they have been loaded. They are of the "safety tuck" type and they are supplied with the tuck already in position. The opening is on the long side. This arrangement is designed to comply with postal regulations for second class mail and printed matter. Envelopes can be added to the stack while the machine is running so that continuous operation can be maintained.

The magazines are fed from the bottom of the stack so that the supply can be replenished while the machine is still running. A micrometer gate allows only one magazine to be fed at a time, and the belt carries it to the inserting fingers. It is slid into the envelope and the filled packet is conveyed to the sealing unit which is next in the sequence.

A feeler mounted alongside the belt detects the presence of a filled envelope and the finger locates the edge of the flap. A following arm then folds and inserts it into the body of the envelope and makes the seal. Farther along the belt another arm operates an electric counter as each magazine passes so that a record of the number packed is kept.

The machine is capable of handling envelopes from 8 in by 5 in up to 12½ in by 9 in; magazines can vary from 7 in by 4½ in up to 11 in by 8½ in and from 4 leaves up to ⅜ in thick. Rates of packing are up to 3,600 per hour. *Bradma Mailing Machines Limited, 2-10 Telford Way, London, W3.*

SCREED VIBRATOR

Slabs up to 24 ft Wide

A NEW screed vibrator will normally handle slabs up to 20 ft wide but can, in favourable conditions, manage slabs up to 24 ft wide and 10 in thick.

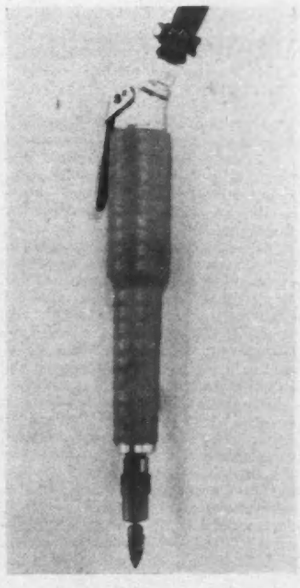
The power unit is a Villiers Mark 10 air cooled four stroke petrol engine developing 1·3 b.h.p. at 3,000 r.p.m. A Bowden cable control is recommended to control the speed of running. Characteristics of the vibrating unit are a frequency of 4,000 vibrations per minute with an amplitude of 0·13 in and acceleration of 5·9*g*.

The basic vibrating unit and the anti-vibrating handle can be mounted on timber screed boards of widely varying width and camber, thus avoiding the high cost of specialised equipment and duplication. As an optional extra a radius type J section steel shoeing, which is claimed to give smoother travel and better compaction with a cleaner finish, can be provided. The shoeing is normally supplied in either 3 ft or 6 ft lengths.

The unit is said to be capable of finishing more work than two 14/10 concrete mixers can produce and to be able to maintain this rate of working continuously. Operator fatigue is reduced as the vibration assists the forward travelling action. *C. H. Johnson (Machinery) Limited, Adswood, Stockport, Cheshire.*

DIE GRINDER

High Speed Pneumatic



THE Grasso S11 die grinder, now available in this country, is designed for use with tungsten carbide rotary cutters and also mounted points.

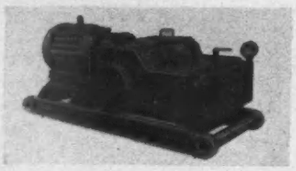
The tool consists of a vane motor flexibly coupled to a grinding spindle running at 22,000 r.p.m. The collets are interchangeable and have a range of sizes of ⅛ in, ¼ in, 3 mm, 4 mm, 6 mm, and 8 mm.

The casing is sheathed in plastics, making it very easy to clean. The tool measures 10½ in long overall and the tapered shape is said to afford a very comfortable firm grip for the operator. The length makes it possible to reach deep internal work and other awkward positions. Control is by the trigger at the base end of the body.

The tool weighs 2 lb and has a normal air consumption of 12 cu. ft per minute. The power to weight ratio is high. It is supplied complete with collet and two spanners for maintenance work. *B. O. Morris Limited, Morrisflex Works, Briton Road, Coventry.*

HYDRAULIC PUMP

Worm Drive



THE type 853W/M hydraulic pump is designed to deliver up to 7·5 gallons per minute at pressures of 1,500 lb per sq. in.

The pump is a three cylinder unit measuring 5 ft long by 1 ft 10 in wide by 1 ft 8 in high (not including the motor). The pump unit is a 1½ in by 2 in horizontal triplex ram pump and the full duty range (depending on the motor) is from 5 g.p.m. at 1,000 lb per sq. in with a 5 h.p. motor running at 950 r.p.m. (pump speed 141 r.p.m.) to 7·5 g.p.m. at 1,400 lb per sq. in with a 10 h.p. motor running at 1,440 r.p.m. The gear ratio is 6·8 to 1.

The motor is a standard foot mounted type and is accommodated on a fabricated base plate with skid ends and welded-in tubes for easy handling. The overall weight has been reduced to a minimum to facilitate handling, and maintenance has been made as simple as possible. The delivery is by ¾ in BSP connection and suction is 1 in BSP. Both are taken from the pump block.

Fabricated steel construction has been used for the crankcase, and cast iron bearing housings are spigotted to the main frame. The base of the case forms the oil sump. A diaphragm crankcase breather is fitted to prevent pressure build up and to exclude foreign matter. The crosshead guide is gunmetal and the circular crossheads are of cast iron. Steel connecting rods are used with bronze bush small end bearings and steel bushed anti-friction split bearings at the large end. The worm wheel is bronze and the worm and shaft Nitralloy steel. Lubrication is positive, the oil being delivered by the worm wheel to a tray forming an oil reservoir from which it is piped to all bearings. A slight degree of tilt will not affect the lubrication efficiency. *Joseph Evans and Sons (Wolverhampton) Limited, Culwell Works, Wolverhampton, Staffordshire.*

TRACTOR SHOVEL

2 cu. yd Bucket

NOW being made in this country is a four wheel drive tractor shovel, the 154D, which has a lifting capacity of 12,000 lb.

A particular feature is the reverse curve lift arms which give the operator full all-round visibility. Even with the bucket raised, the arms are below the operator, removing any possibility of his receiving an injury from them as the bucket drops.

Power is supplied by a Leyland diesel engine type UE350 which develops 105 h.p. at 2,200 r.p.m. from six cylinders. The drive is through an Allison torque convertor with fully automatic planetary transmission giving three forward speeds and reverse. No manual shifting in the range is required. The torque converter has a ratio of 3·5 to 1. The final drive reduction in the hubs consists of three planetary gears: one floating sun wheel, one floating ring gear, and one ring per hub. Lubrication is simple and efficient.

Normally a 2 cu. yd general purpose bucket will be fitted, but optional sizes of 1½ and 2¾ cu. yds are available. The lifting cylinders are mounted horizontally to give a thrust approximately parallel to the line of tractive effort so that the maximum use may be made of hydraulic and tractive forces. The weight distribution is such that at least 55 per cent of the unladen weight is on the rear steering axle. Wheel base and track width are bigger than normal. *Yale and Towne Manufacturing Company, Willenhall, Staffordshire.*

SPARK EROSION MACHINE

Includes Screw Cutting

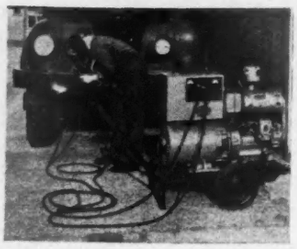
THE VJK2 is a spark erosion machine for die cutting and general work.

The tool is carried on a work head which can be raised and lowered giving a controlled straight line feed for die sinking and boring and a controlled rotary feed with downward movement for cutting screw threads. Longitudinal and transverse movements are hand operated to locate the tool over the work. At the bottom, the arm carries the work table with its clamping assembly and the whole arm and table are raised and lowered into the kerosine bath by an electric motor. The bath can be slid out for cleaning.

The maximum machined surface is 31 sq. in and the table is 15⅜ in by 12¾ in. The workpiece can have maximum dimensions of 13¾ in by 11¾ in. The head has a vertical travel of 7½ in and horizontal travel of 7½ in. The automatic stroke of the head is 9⅜ in. The machine is designed to operate at voltages of 160 to 220 with capacity steps of 2, 6, 16, 69, 180, and 400 μF. The input is 10 kW. Floor space required is 50 in by 32 in and the machine stands 67 in high. *Strojexport, 6 Upper Belgrave Street, London, SW1.*

POWER UNIT

Lighting and Welding



A POWER unit that will supply electricity for lighting, hand tools and welding is now on the market.

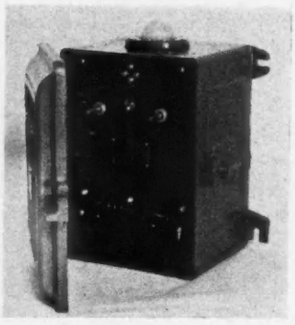
The Youngster power pack Mark II is a mobile multi purpose unit designed for light weight (it weighs 960 lb) so that it can be transported by helicopter and dropped by parachute. Power is supplied by a diesel engine that develops 10 b.h.p. at 3,000 r.p.m. This drives a 7·5 kVA alternator which will generate electricity at 250V a.c. for lighting purposes and power tools. In addition there are ranges for welding currents of from 25 to 175A a.c. at 50 cycles. A special attachment for the machine facilitates the cutting of armour plate up to 3 in thick and the piercing of plate up to 6 in thick.

The unit is mounted on a two-wheel chassis so that it can be moved about by one man. Pneumatic tyres are fitted. When on site the wheels can be retracted by a simple operation to allow the unit to rest solidly on four anti-vibration mountings. Alternatively, the Youngster can be mounted on a 10 cwt trailer for high speed road towing behind a vehicle.

The unit was primarily developed for military use in field workshops, but it is equally suited for work on construction sites where power is required. It will supply such items as flood lights for night work, drainage pumps, drills, compressors and lathes up to its capacity of 7·5 kVA. The whole design has been directed towards reliability and robustness coupled with compactness, economy and light weight. *Ashton-Young Engineering Development Company Limited, 76 Cambridge Road, Kingston-upon-Thames, Surrey.*

LIGHTING CONTROLLER

Automatic Response



AUTOMATIC operation of artificial lighting can be obtained by the type DCR switch.

This unit is designed to operate on the level of daylight existing at any time and will switch on or off the lights accordingly. There are two models: the first has an adjustable range of incident light from 0·2 to 5 ft-candles and the second from 2 to 50 ft-candles. Operation is from a 200/250 volt a.c. supply.

Light falling on the dome strikes the photocell and causes the contacts to open or close at the set values. A delay of 30 seconds occurs before the contacts will change to allow for temporary fluctuations. A switch allows this delay to be cut out if desired, as would be the case during setting up. Adjustment can be made through the door.

All components are mounted on a printed circuit board which is fixed behind the front panel. The unit is mounted in a substantial weather proof cast iron casing with four lugs for fixing to a wall. The output relay in the unit has contacts rated for 3A at 250V a.c., and this can be increased by the use of a mercury switch relay, type LQA, which has a capacity up to 60A at 350V a.c. The unit measures 9½ in wide by 10½ in high by 6⅜ in deep. The dome over the cell projects an additional 1 1/16 in. Apart from its use for indoor lighting, the unit is suitable for controlling display signs and street lighting for unattended areas. *Londex Limited, Anerley Works, 207 Anerley Road, London, SE20.*

POWER RAMMER

Direct Fuel Injection

A NEW power rammer is claimed to be the only one of British design using the direct fuel injection system.

The Trenchmaster has a flange mounted injection pump which sprays atomised petrol into the cylinder. The method is said to give improved fuel consumption. The operation is semi-automatic; a common trip handle carried on the guide handle controls both the fuel injection and ignition systems, giving immediate and continuous operation. Ignition is by magneto and sparking plug.

Two sizes of forged steel ramming feet may be used; either 10½ in or 7½ in diameter. They are detachable from the piston rod for maintenance. Springing is provided to absorb all shocks. The machine stands 4 ft 2½ in high and weighs 236 lb. The jump is 20 in with an impact force of 9,000 lb, the average rate being 50 per minute. A petroil 40 : 1 mixture is used, at 1 pint per hour. A two wheel transport trolley is available. *Pelapone Limited, Derby.*

Pattern of Control

Nuclear reactors present not only engineering and scientific problems but also legal ones. Problems of control arise from the fact that nuclear energy has military as well as peaceful uses, so that countries capable of producing enriched uraniun or plutonium have to ensure that the materials they supply do not get into military hands. This again raises problems over the interpretation of the provisions of such international agreements as the Rome and the Euratom Treaties. Apart from security control there are all the difficulties arising from the fact that radioactive substances are dangerous to handle. And finally the exploitation of atomic power is so costly that only special organisations with a measure of public control could afford to carry it out. In addition to the special legal problems peculiar to atomic energy a number of more conventional difficulties such as the protection of inventions and third-party cover against risk of injury also have to be provided for. The question of atomic law and administration is the subject of the second volume of the report of the Stresa Conference of the OEEC which has just been published. (*The Industrial Challenge of Nuclear Energy—III Stresa Conference Part 2: Atomic Law and Administration.* Published by OEEC. Obtainable from HMSO price 18*s* 6*d*.)

Patterned After Britain

How is the nuclear industry controlled in different European countries? Everywhere the industry is based on the combined efforts of international bodies, national governments and private industry. In each country there is a central authority of some kind which controls the nuclear industry on behalf of the State. In Britain the UKAEA is a public corporation set up by an Act of Parliament in 1954 to cover both military and peaceful uses. The chairman and members are appointed by the Prime Minister and the link between the UKAEA and government departments is provided by the Atomic Energy Office. The Authority draws up the research programme, has a monopoly of imports of nuclear materials, builds experimental and power reactors, and manufactures nuclear weapons by arrangement with the Services and Ministry of Supply. Private enterprise is brought in under the Nuclear Installations (Licencing and Insurance) Act. The British system has been followed more or less closely by other countries. In France the Commissariat à l'Energie Atomique (CEA) is also concerned with military and peaceful uses of nuclear energy but the building of power reactors is done by another public body, Electricité de France (EDF) analogous to the UK Generating Boards. Private companies are now allowed to build reactors but only if EDF has a 50 per cent share and therefore exercises effective control. In Italy the Comitato Nazionale per le Richerche Nucleari (CNRN) is an autonomous body whose activities in research are subordinate to the Ministry of Education, and in industry to the Ministry of Industry and Commerce. In Germany the comprehensive state-owned system is replaced by an arrangement consisting of a public body, the Federal Ministry for Nuclear Energy and Waterworks, and a corporation with half its shares privately owned for building and operating nuclear reactors. Belgium has a similar dual system with the public Commissariat à l'Energie Atomique and the Centre d'Etude de l'Energie Nucléaire (CEN) with its research centres at Mol representing private industry. The smaller European countries have variations on the arrangements described.

Division of Functions

Security control and research are both reserved unconditionally to the state in all cases. The major difference in national practice is over the question of who should run the nuclear industry. Where military applications of atomic energy are important as in Britain and France the emphasis is on public control. Elsewhere private development of nuclear installations is more usual. In either case the control of trade in nuclear fuels is a state responsibility. The Euratom Treaty provides that all nuclear fuels produced or imported by member states shall remain the property of Euratom but in the six Euratom countries the operator of any particular undertaking bears the liability for any radiation hazard. The OEEC draft convention on third party liability in the field of nuclear energy provides that the transport of nuclear fuels will be at the operator's liability.

Information and Protection of Patents

The Euratom Treaty devotes a whole chapter to the "dissemination of information." The regulations vary according to whether they relate to a patent which is the property of Euratom or of a private firm. The Euratom Commission is considering whether to set up a documentation centre to collect, sift, classify and file the widest possible range of technical information. If this idea is taken up the documentation will all be in English and the centre will be located at the Joint Nuclear Research Centre. Apart from information which Euratom derives from general technical literature it also collects data from the notification of patents from the patent offices of the six member countries. These notifications are made subject to two conditions in the Euratom Treaty. These are that notifications are regarded as confidential by the Euratom Commission and are required for documentary purposes only.

Euratom and the Individual

Industrial exploitation of technical information under the Euratom Treaty is based on two essential principles. The first is that the intellectual and material property of the inventor must be safeguarded. The second is to secure the widest possible dissemination and industrial exploitation of the information by qualified undertakings in the Euratom area. Complications arise in the case of patents and inventions based on research agreements between Euratom and private firms. In theory a private patent owner is free to decide whether and on what terms he is prepared to grant a licence to Euratom. The negotiations for a licence must be conducted according to normal practice on a private business basis. If agreement cannot be reached the Euratom Commission may be asked to use its good offices. If this fails the Euratom Treaty provides for compulsory licences to be issued under conditions which vary according to whether the licence is required for Euratom and the Joint Nuclear Research Centre or for some industrial firm. The patentee has the right to claim a stay of execution in order to exploit his patent himself. If a compulsory licence is issued he may claim full compensation. And as a third safeguard the patentee may decide whether the compulsory licencing procedure shall be carried out by the Euratom Arbitration Committee or under national arrangements. This provision for compulsory licencing has been described as "a break with the recognised principles of patent law in civilised countries." Against this it is argued that nuclear energy is a matter of extreme international importance so that exceptional powers are necessary. In any case compulsory licencing is hedged around with conditions and legal safeguards.

No Patent Rights in USA

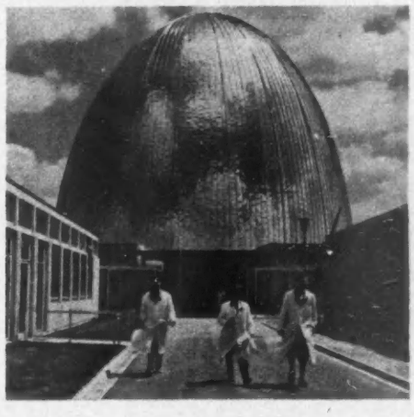
In the United States the Statute of the Atomic Energy Commission requires that all scientific and technical data should be as widely disseminated as possible subject only to defence and security considerations. Classification is carried out in the light of whether information can be published "without undue risk to the common defence and security." A procedure has been worked out for brining material classified "secret" regularly under review. United States patent law relating to atomic energy has a number of unique features. The first is that there shall be no patent rights on an atomic weapon (Sec. 151). An award system, said to be generous, has been set up to take the place of patent rights. A second unique feature is that any inventor with an invention on atomic energy must report it to the AEC or US Patent Office within 90 days of its discovery (Sec. 151). Thirdly all inventions resulting from a contract with the Commission are presumed to be Commission property (Sec. 152). The provision for compulsory licencing (Sec. 153), although in being, has never been used.

In Britain a large proportion of patents in the nuclear field are held by the UKAEA. These include inventions of UKAEA employees and patents, mostly early, obtained by interchange with the USAEA and others that have arisen from contracts placed by the UKAEA. Licences granted by the Authority are subject to the payment of royalty. Patents for nuclear energy inventions are not treated as confidential by the patent office but are disclosed to the Atomic Energy Office which decides whether questions of military security are involved. Provision for compulsory licencing of nuclear energy inventions is made under Sec. 106(3) of the Patents Act, 1949. But, as in the United States, these very "broad" government powers have never been used.

Third Party Liability and Insurance

From the insurance point of view the problems arising from the use of atomic energy are new and the extent of the liabilities largely unknown. Further the amounts involved are very large and represent a heavy concentration of risk in one place. This is a situation which in general insurers try to avoid. In Britain and elsewhere the individual insurers decided that the only way to deal with atomic insurance problems was by forming national pools. The day to day running of these pools is by small committees with power to decide acceptances and rating problems. One important point is that there are no reserves accumulated against nuclear risks.

What do insurance companies want to know in taking on nuclear liabilities? First there is the



Nuclear Energy in Europe: how to protect the inventor, the operator and the public. Illustrated is Munich University's reactor building.

Evaluation Report, a substantial book which reactor operators and manufacturers have to supply to civil authorities for the purpose of obtaining a licence. A document of this kind is provided under one name or another in all countries where nuclear engineering takes place. Secondly insurance companies are interested in the siting of reactors, especially whether they are in densely or sparsely inhabited areas, whether there is flood danger, the direction of the prevailing wind and so on. Information is also required on the type of fuel, where it is stored and how it is transported. Most important of all is the Code of Practice which sets out the administrative system of operating the reactor. This involves the human element in reactor operation, a matter of vital importance to the insurers in deciding on the risk involved. The size of premium varies from one reactor to another according to conditions. In short, premiums will be "tailor-made."

Financial Security

The OEEC draft convention has been drawn up to define the principles for a nuclear insurance system. The system is based on *absolute liability* which means that the operator of a nuclear installation is liable in the event of a nuclear incident without proof of fault or negligence. The corollary to absolute liability is that liability should be limited, both as to its maximum amount, and in respect of the period of time after an incident in which an action can be brought. The limitation in amount is at present set at $15 million in the OEEC Draft Convention, but states may, through special national legislation, set lower limits not below $5 million. A necessary element in the system is that no one is permitted to operate a nuclear installation with financial security below $15 million. The OEEC Convention seeks to provide a single forum and a single tribunal for nuclear incidents so as to avoid the possibility of complicated cross-actions in the courts of the different countries involved. The Convention also contains a provision for the enforcement of judgments given by the competent courts.

Nuclear Installations Act Now in Force in UK

On April 1 the Nuclear Installations (Licensing and Insurance) Act, 1959, came into force and

licensing requirements already apply to two privately owned research reactors: AEI's MERLIN and Hawker Siddeley's JASON. Similarly, the Generating Boards will be required to obtain a licence for the nuclear power stations now under construction. As Section 6 of the Act provides for action to be taken in case of a dangerous occurence on a licensed site, the Minister of Power and the Secretary of State for Scotland have jointly presented to Parliament a set of regulations specifying the types of occurance which come under the regulations of the Act. Operators of licenced sites will be required to report occurrences likely to result in emission of radiotoxic substances in connection either with the operation of facilities or the transport of radioactive materials.

Notes and News

Conferences for Working Holidays

For those planning to organise a working holiday by attending conferences in far away countries there are new opportunities in Copenhagen, Prague and Sydney. From 23 to 25 May, a conference on the industrial applications of ionising radiation will be held at the University of New South Wales in Sydney, Australia. From 6 to 17 September the uses of radioisotopes in the physical sciences and industry will be discussed in Copenhagen under the sponsorship of the IAEA and UNESCO. It is anticipated that more than five hundred scientists from the seventy member countries will participate. And finally, October in Prague: from 24 to 27; papers on the chemical effects of nuclear transformations will be presented, including post-irradiation effects and annealing phenomena, reactions of accelerated ions, applications of energetic-atom chemistry and recoil labelling, and the chemical effects of all forms of nuclear transformations in solid, liquid and gaseous media.

Sine-Curve Tubing for Enrico Fermi Station

To accommodate differences in thermal expansion between tubes and shells, a sine-wave pattern shown in Fig. 1 has been developed for the sodium heat exchangers of the Enrico Fermi fast breeder reactor. Advantage of the sine-wave pattern is that it permits removal of the tube bundle from the shell without the need for cutting any tubes. The sodium to sodium heat exchanger tubes are type 304 stainless steel with $\frac{3}{4}$ in outside diameter, 18 gauge wall thickness. A special machine was designed by Alco Products to produce the sine-curve by cold bending. Performance of the heat exchangers, of which three

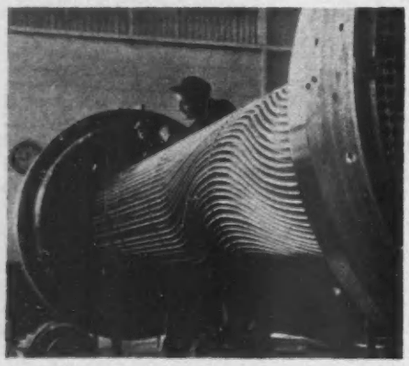


Fig. 1 Sine-wave pattern of heat-exchanger tubes permits differential expansion between shell and tubes, but allows removal of the tube bundle.

will be supplied to the station, will be 489 million Btu per hour at a flow rate of 12,500 gallons per minute. The primary sodium flows by gravity from the reactor at a temperature of 900° F (482° C) through the shell side and is pumped back at 600° F (316° C). An intermediate sodium loop transfers the heat to steam raising units, where the maximum temperature is 820° F. The heat-exchanger shells are 88 in diameter and nearly 31 ft long. A layer of shielding 16 in thick is provided, raising the weight of each unit to 65 short tons. The estimated cost of the complete heat-exchanger set is almost 82 million.

New Use for Depleted Uranium

Several commercial applications of depleted uranium, a by-product available in large quantities from gaseous diffusion plants, are studied in the United States. For instance, uranium 238 could be used as an anode for cathodic corrosion protection of underwater structures, replacing zinc. Another application, studied by the US Bureau of Mines, is in beneficiation. Uranium being the heaviest element, it could be used to advantage in the separation of mineral slurries as a carrier. The qualities of uranium as an alloying element and as a potential catalyst in chemical processes is also receiving attention. Chief difficulty in non-nuclear applications of uranium 238 is the accompanying slight but persistent radioactivity which will necessitate special handling. If the projects are successful, the increased commercial value of uranium 238 may lower the prices of enriched uranium.

Braided-Wire Control Gear Saves Space

To conserve space around the pile cap of reactors, the Industrial Branch of the UKAEA have developed a new compact winding gear for control rods. Replacing a somewhat bulky spool and traversing mechanism that guides the suspending wire to form

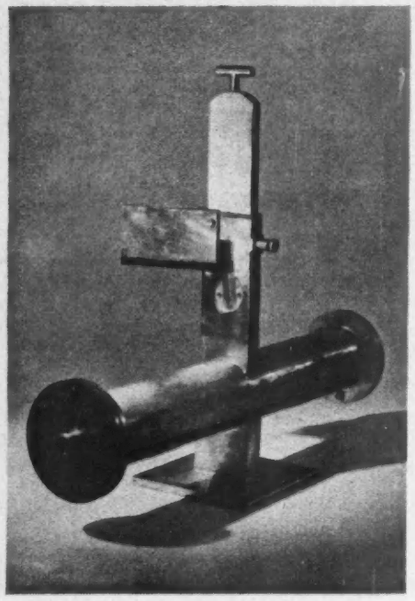


Fig. 2 High sensitivity beta counter using photomultiplier tubes, designed for the detection of low concentrations of tritium.

neat layers as it is wound up, the new mechanism uses a flat strip of braided wire to support the control rod, wound on a spool like typewriter ribbon. The strip is formed by flattening a length of tubular stainless-steel wire braid, which is capable of supporting a considerable load and is resistant to edge-tearing. The chief disadvantage of the product is stretching, for which allowance must be made in the design. The idea is available for commercial exploitation from the UKAEA.

Fuel Reprocessing in Russia

A new process for recovering uranium and isolating plutonium from spent reactor fuel elements has been developed at the Institute of Nuclear Physics of the Soviet Academy of Science. The process is based on solvent extraction using a mixture of dibutyl ether and carbon tetrachloride, and results in 99·9 per cent uranium, and 98 per cent plutonium recovery, reports the Czechoslovak *Technical Digest*.

Flux Scanning with Integral Counting Device

Scanning equipment to chart the neutron flux distribution in the Trawsfynydd reactor will have counting equipment incorporated in the standpipe head of the instrument, obviating the need for handling the active wire outside the pressure vessel and breaking the seals for removal. The standard wire activation method is used as developed for Calder Hall, but incorporation of integral counters is a significant improvement. The scanning heads are attached to the standard control-rod standpipes. Two tungsten wires are used alternatively in each head, both being irradiated for about half an hour. Before a wire can be re-used, a week must be allowed for the activity to decay to less than 1 per cent of maximum. With the two-wire system, each instrument can be used once in three or four days. Winding drums holding 80 ft of tungsten wire are driven by alternating-current induction motors, with limit and indicating switches operated by gear trains and cams. Elliott-Automation will supply the equipment.

Detecting Tritium

Tritium is difficult to detect as the emitted beta radiation is very weak, with a maximum energy of only 18 keV. An apparatus has been developed by the medical division of the UKAEA in which 0·001 microcuries of tritium may be quantitatively estimated at room temperature with an accuracy of ±10 per cent. The apparatus consists of a $\frac{1}{2}$ in thick brass shaft to hold the sample, two high-sensitivity photomultiplier tubes, and a holding device which permits loading of samples without the admission of daylight. The background noise can be greatly reduced if the apparatus is cooled from room temperature to −10° C, and cooling coils can be readily applied to the extension of the holding device in which the photomultipliers are housed. Fig. 2 shows the apparatus with the loading shaft raised and loading window open. (W. P. Hutchinson: "Liquid Scintillation Counting of Tritium at 22°C," AERE Report R3238, HMSO, 2*s* 6*d*)

Expenditure for Dragon Project

It appears that the total sum of £13·6 million set aside for project Dragon will be spent at an even rate during the project's five year life-time. The budget for the year 1960-61 accounts for £2·83 million, or slightly under one-fifth of the total allotted. The year's budget will be evenly split for reactor construction, research and development, and operating costs. The project's staff will be brought up to the full strength of 240 within three or four months. Half of the senior staff members come from the United Kingdom, half from OEEC member countries.

Safe Handling of Radioisotopes

"In almost every case where radiation is a hazard, it is no more of a hazard than electrocution, falls, fires, or the other common causes of injury with which we are all too familiar. Over an 11 year period in the American atomic energy programme, two people have died as a result of radiation injuries, while 184 have died of 'normal type' industrial accidents." To maintain the excellent industrial safety record of the atomic energy industry in spite of the expanding commercial and industrial application of radiation, the British Safety Council has published a book, *Safety Spotlight Isotopes*. The remark opening this paragraph is a quotation from the introduction written by Leonard D. Hodge, national director of the council. The booklet gives a brief list of radioisotope applications in industry, medicine and agriculture, and an introduction to radiobiology, genetics and dosimetry. The bulk of the booklet is concerned with the practical problems of handling radioactive materials and setting up the necessary organisation for a radiation protective service. The booklet points to the safety record of the American nuclear industry as a desirable target: the USAEC has operated some 25 reactors over a period of 12 years without a single fatal accident, and the injury record of the Commission's programme, 2·01 injuries per million man-hours, received the National Safety Award in 1955. Of the 150,000 atomic workers in the United States, at least 99·7 per cent are eligible for life insurance without payment of extra premiums as a result of the excellent safety record. This still leaves some 450 workers, or 0·3 per cent, who cannot be insured at the normal rates.

Reactor Notes

Spurt of SPERTS: The fourth reactor in the power excursion test series of the USAEC, SPERT-IV, is now being designed, while SPERT-II, a light or heavy water moderated reactor, has just achieved criticality. Over a thousand power excursions have been performed with the oldest member of the series, SPERT-I.

Flock of Kiwis: Preparations for the ground testing of nuclear rocket engines at Jackass Flats are continuing with the construction of two more reactors in the Kiwi series. The reactors will be used to determine safety margins, limits of performance and the endurance of nuclear rocket engines.

Superfast Excursion: Project Gnome for the testing of heat and isotope production with nuclear explosions is now under preparation. The blast will be set off in a salt cavern near Carlbad, New Mexico, but not for a long time: preparation of a mile-long complex of tunnels will take about a year.

Avogadro Calibrated: The one megawatt research reactor Avogadro, supplied to the SORIN centre by AMF Atomics, has recently been brought to maximum power for control-rod calibration.

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37 BAKER STREET, W.1.

B 756

BOILER HOUSE SUPERINTENDENT

B.I.P. CHEMICALS LTD., require at their Oldbury group of factories a Superintendent to take charge of a new and modern boiler house, supplying steam for process and generation. Applicants should be fuel technologists and have been in charge of a modern boiler house of not less than 80,000 lb./hr. capacity and be conversant with up-to-date boiler control and instrumentation. The Company offers good conditions of employment and has a generous Pension and Life Assurance Scheme.—Applications should be made in writing giving full details of qualifications and experience to:—

PERSONNEL MANAGER,
B.I.P. CHEMICALS LTD.,
POPES LANE,
OLDBURY, BIRMINGHAM.

B 755

THE UNIVERSITY OF BRITISH COLUMBIA

Applications are invited for the position of

ASSISTANT PROFESSOR

in the Department of Mechanical Engineering. Applicants should possess a good research degree and have an interest in thermodynamics, combustion and heat transfer. The appointee will be expected to actively pursue a programme of research in his field of interest, and to supervise graduate students as well as do undergraduate teaching.

Please submit full details with application, including references, which may be addressed to—

Head, Department of Mechanical Engineering,
University of British Columbia,
Vancouver 8, B.C.

B 609

PUBLIC APPOINTMENTS

AIR MINISTRY

AIR MINISTRY require ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS for design, construction and maintenance of installations on airfields, radar stations, missile bases, workshops and maintenance units for R.A.F. at home and overseas as well as certain Civil Airports. Salary: £805 at 25 to £1095 at 34 or over, thereafter rising to max. £1260 with increase for London and slight decrease for country districts. Appointments non-pensionable but long term. Promotion prospects. Five-day week with 4 weeks 2 days leave a year initially. Special allowance in addition to salary during overseas service. Quals. and experience:—

(i) (*a*) University degree or equiv. diploma in electrical and/or mechanical engineering with at least 2 years apprenticeship; or (*b*) Graduate or corporate member of I.E.E. with at least 3 years apprenticeship; or (*c*) Graduate or corporate member of I.Mech.E. appreciable electrical engineering experience with at least 3 years apprenticeship; and

(ii) Have been employed for minimum of 2 years with well established engineering concern and gained wide experience in both electrical and mechanical engineering practice.

Applicants must be natural born British subjects between ages of 25 and 45.

Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting D.158/OA. B 531

NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY

ST. JOHN STREET,

LONDON, E.C.1

DEPARTMENT OF PRODUCTION TECHNOLOGY AND CONTROL ENGINEERING

I

Applications are invited from Honours graduate for the post of READER in this newly formed Department.

The work of the Department is primarily concerned with the Diploma in Technology and post-graduate courses.

The person appointed will pursue one of the three main interests of

(i) Measurement and Automatic Control.
(ii) Production Methods and Processes.
(iii) Industrial Organisation.

and will be required to devote most of his time to the development of research in his chosen field and the supervision of research students.

Salary Scale: £1800 by £50 to £2100 per annum, plus London allowance of £38 increasing to £51 at age 37.

A modicum of private consulting practice by the appointed person will be encouraged.

Particulars and forms of application from the Secretary.

II

Applications are invited from Honours graduates for the post of PRINCIPAL LECTURER in Production Methods and Processes.

The work of the Department is primarily concerned with the Diploma in Technology and post-graduate courses. The person appointed will be responsible for leading the work in his subject at under- and post-graduate Honours level and for developing research and the laboratories of the Department.

Salary Scale: £1788 by £50 to £1951 per annum.

A modicum of private consulting practice by the appointed person will be encouraged.

Particulars and forms of application from the Secretary.

III

Applications are invited from graduates for posts in the class of LECTURERS in this newly formed Department. The vacancies arise from the expansion of the work which is primarily concerned with the Diploma in Technology and post-graduate courses.

The persons appointed will pursue one of the three main interests of the Department, namely:

(i) Measurement and Automatic Control.
(ii) Production Methods and Processes.
(iii) Industrial Organisation.

They will be encouraged to undertake research or development work and may be required to assist in industrial liaison.

Salary scales range from £895 to £1750 per annum with a London Allowance at each point of £38 (£51 at age 37 upwards). A modicum of private consulting practice is encouraged.

Particulars and forms of application from the SECRETARY. B 737

UNIVERSITY OF ST. ANDREWS

Applications are invited for an EDWARD A. DEEDS FELLOWSHIP in QUEEN'S COLLEGE, DUNDEE, for research in Engineering, Metallurgy, Chemistry, Physics, Mathematics or any cognate subject, from 1st October, 1960. The Fellowship (open to persons of either sex) will be tenable for three years. The amount will be £900 per annum, subject however to upward revision; F.S.S.U.; Family Allowance; University Lecturer status. Fellow may be required to do a limited amount of teaching in the Department in which appointed. Applications (ten copies) with names of three referees, to the undernoted, not later than 10th May, 1960.

PATRICK CUMMING,
JOINT CLERK TO THE UNIVERSITY COURT,
QUEEN'S COLLEGE, DUNDEE.
March, 1960. B 741

ENGINEERING DRAUGHTSMEN

There are vacancies for DRAUGHTSMEN at the various Birmingham Works of the West Midlands Gas Board. The posts are on the staff of the Divisional Engineer and offer excellent opportunities for gaining experience in a wide field of engineering activity.

One post is within the salary range of £733-£927 per annum and candidates should hold a Higher National Certificate in Civil or Structural Engineering or equivalent qualification.

The remaining posts are within the salary range of £629-£709 or £629-£813 per annum according to experience. Candidates for these posts should have completed a drawing office apprenticeship or have equivalent experience and have reached at least Ordinary National Certificate level in Civil, Mechanical or Structural Engineering.

Pension scheme and attractive conditions of service.

Applications, stating age, qualifications and experience, should be addressed to MR. J. E. WAKEFORD, DIVISIONAL GENERAL MANAGER, WEST MIDLANDS GAS BOARD, EDMUND STREET, BIRMINGHAM, 3. B 729

THE BOARD OF GOVERNORS

THE HAMMERSMITH AND ST. MARK'S HOSPITALS,
DU CANE ROAD, LONDON, W.12

APPOINTMENT OF CHIEF ENGINEER

Applications are invited for the appointment of CHIEF ENGINEER of the Hammersmith and St. Mark's Hospitals, a postgraduate general teaching group of hospitals. Candidates must hold corporate membership of the Institution of Mechanical Engineers or an equivalent qualification in mechanical engineering. A recognised qualification in electrical engineering would be an advantage.

Salary scale, £1375 by £45 (5) to £1600 p.a., plus £50 London Allowance. A gratuity of up to 10 per cent. of salary will also be payable for hours worked in excess of normal 38-hr. week.

An additional payment will be made for supervisory duties for other authorities on the Hammersmith Hospital site.

The successful candidate will be required to take up his duties on the 1st November, 1960.

Full details of duties and conditions of service may be obtained from the SECRETARY of the Board.

B 728

DRAUGHTSMAN

Applications are invited for the above post, which located in Birmingham.

The work is interesting and varied and is mainly in connection with the design of industrial heating equipment. A knowledge of combustion technique and the use of refractories would, therefore, be an advantage.

Candidates should possess the Ordinary National Certificate in Mechanical Engineering as a minimum qualification.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £733-£853 per annum.

Applications, stating age, qualifications and experience, together with the names of two referees should be addressed to the INDUSTRIAL RELATIONS OFFICER, WEST MIDLANDS GAS BOARD, 6, AUGUSTUS ROAD, EDGBASTON, BIRMINGHAM, 15. G 848

Assistant Chief Engineers

SALARIES

will be between £2400 and £2900 according to qualifications and experience.

Contributory Superannuation.

Housing will be available.

APPLICATIONS

Write for application form, quoting appropriate reference number, to: Group Recruitment Officer,

DEVELOPMENT AND ENGINEERING GROUP

U.K.A.E.A.

Risley, Warrington, Lancs.

Closing Date: 14*th April*, 1960

DUTIES

Post I (Ref. 206/J2)—To control the work of several sections engaged on the design of large chemical projects. The work will include novel and conventional engineering problems arising from the use of special materials and will involve provision for the remote operation of plant and equipment as well as design of associated laboratories and services.

Post II (Ref. 207/J2)—To control the work of several sections engaged on the design of metallurgical and mechanical engineering plant installations. The plants are required to handle unusual metals involving the design of new equipment for vacuum casting, pressing, rolling, heat treatment, machining, welding and powder metallurgy processes.

QUALIFICATIONS AND EXPERIENCE

All applicants must have served a recognised engineering apprenticeship and be corporate members of a senior engineering institution or have equivalent qualifications.

For Post I considerable experience of work at a senior level on high quality mechanical or chemical engineering design is essential and possession of an honours degree in either of these may be an advantage.

For Post II considerable design experience at a senior level in a similar field, but not necessarily in nuclear engineering, is essential. Some experience of constructional work and of plant installation would be an advantage. B 726

CENTRAL ELECTRICITY GENERATING BOARD

SOUTHERN, SOUTH WESTERN AND SOUTH WALES REGION

SECOND ASSISTANT ENGINEERS (STANDARDS)

Regional Standards Department

Applications for two posts at Regional Headquarters, Bristol, are invited from Engineers who will be required to assist in the standardisation of general engineering stores used in power station and main transmission system maintenance.

This will involve the initiation of proposals for standard ranges and types of stores designed to reduce unnecessary variety and the preparation of appropriate specifications.

Development of Engineering Standards within the C.E.G.B. is interesting and expanding work and will eventually be extended to plant spares.

Whilst a knowledge of Standardisation work is not essential, it is desirable that applicants should have a good knowledge of power station or transmission plant and have had workshop and drawing office experience. Applicants should also be of H.N.C. level.

The posts will be placed within Schedule B, Class AX/EX, of the National Joint Board Agreement for the Electricity Supply Industry, and graded in one of the following two salary scales according to the qualifications and experience of the successful applicants:—

Grade 3 £1365 × £25 — £1490 — £1630

or

Grade 4 £1180 × £25 — £1305 — £1146

Applications on form AE6/ACT, obtainable from the

REGIONAL SECRETARY,
CENTRAL ELECTRICITY GENERATING BOARD,
SOUTHERN, SOUTH WESTERN AND SOUTH WALES REGION, 1 EATON CRESCENT, BRISTOL, 8,

accompanied by any additional information thought necessary, should be returned to him by not later than first post on Friday, 22nd April, 1960.

Regional Vacancy Notice No. 51 should be quoted on the application. B 739

THE DISTILLERS COMPANY LIMITED

PROJECT ENGINEER

The Company invites applications for an appointment as Project Engineer in the Chemical Division; attractive opportunities for further progress within the Division and the Company are attached to this post.

A Project Engineer is concerned with the design, installation and maintenance of carbon dioxide equipment supplied to customers, and with giving customer service on technical problems; he supervises the work of at least five Field Service Engineers.

This vacancy arises in the London headquarters of the Division. Candidates, aged between 25 and 35, should hold a degree or equivalent professional qualification in mechanical engineering and should have practical engineering experience. Knowledge of pressure vessels for chemical plant is an essential qualification, and some experience of electrical installations would be an advantage.

Write:

STAFF MANAGER
THE DISTILLERS COMPANY LIMITED
21-22 BOLTON STREET
LONDON, W.1

Quote Ref.: 28/60 E. B 743

CITY OF NOTTINGHAM

WATER DEPARTMENT

APPOINTMENT OF TWO CIVIL ENGINEERING ASSISTANTS

Applications for the above permanent, pensionable appointments are invited from Engineering Graduates and/or Corporate Members of the Institution of Civil Engineers with at least five years' satisfactory experience. Salary dependent upon qualifications and experience, in Grade A.P.T. IV, viz., £1065 by £55 by £50's (2) to £1220.

Applications with names of two persons to whom reference may be made, to ENGINEER AND GENERAL MANAGER, WATER DEPARTMENT, CASTLE BOULEVARD, NOTTINGHAM, not later than 25th APRIL, 1960.

T. J. OWEN,
TOWN CLERK.

THE GUILDHALL,
NOTTINGHAM. B 767

IMPERIAL COLLEGE

HOLLERITH RESEARCH STUDENTSHIP

available for research on a subject allied to automatic computing or the application of automatic computers to commercial or industrial accounting or control. Value, £400 p.a. plus fees.—Application to the REGISTRAR, IMPERIAL COLLEGE, LONDON, S.W.7, from whom further details may be obtained. Closing date, June 1st, 1960. B 725

IMPERIAL COLLEGE

BURSARIES IN STRUCTURAL STEELWORK

Bursaries provided by the British Steel Producers' Conference and the British Constructional Steelwork Association are available for the postgraduate course in Structural Steelwork dealing with the application of modern analytical and design methods to practical design problems.

The value of the bursaries is from £475 to £775 from which fees (£64) will be payable, for the period from October, 1960, to July, 1961. Applicants must have a good first Degree in Civil Engineering or equivalent qualification and preferably some practical experience in structural steelwork design. Applications including the names of two referees should be made by June 1st, 1960, to: THE REGISTRAR, IMPERIAL COLLEGE, LONDON, S.W.7, from whom further particulars may be obtained. B 731

MIDDLESEX COUNTY COUNCIL

EDUCATION COMMITTEE

SOUTHALL TECHNICAL COLLEGE

Applications are invited for the following post, duties to commence 1st September, 1960.

LECTURER to teach Theory of Machines in Higher National Diploma and Higher National Certificate Courses with subsidiary mechanical engineering subjects. Candidates should preferably be University graduates in Engineering or hold an equivalent qualification together with appropriate industrial and/or teaching experience.

Salary within the range: £1408-£1601 per annum.

Forms of application and further particulars may be obtained from the PRINCIPAL, SOUTHALL TECHNICAL COLLEGE, BEACONSFIELD ROAD, SOUTHALL, MIDDLESEX (foolscap s.a.e.). Forms returnable within 14 days of the appearance of this advertisement.

C. E. GURR, M.Sc., Ph.D.,
SECRETARY TO THE EDUCATION COMMITTEE. B 745

CIVIL ENGINEERS

FOR DEPARTMENT OF MAIN ROADS

NEW SOUTH WALES, AUSTRALIA

Applications are invited from GRADUATES (or undergraduates in their final year) in Civil Engineering of a recognised British or Irish University for appointment to the staff of the Department of Main Roads, New South Wales, the State Road Authority for construction of roads and bridges.

On appointment, applicants may be engaged at the Department's Head Office, Sydney, on the design of reinforced concrete and steel bridges, or on main road construction and maintenance either in the Metropolitan Area or the country.

Commencing salary according to qualifications and experience will be within the range £A1185 to £A1410 per annum, with annual progression, subject to technical competence to £A2095 per annum. Appointees will be eligible to contribute to the State Superannuation Fund after six months.

Appointee's full fare from England to Australia will be met by the Department, subject to a three years' service guarantee bond being completed. Appointment will be subject to passing a medical examination and preference will be given to applicants not more than 30 years of age.

Applications should be made on forms obtainable from the AGENT GENERAL FOR NEW SOUTH WALES, 56 STRAND, LONDON, W.C.2. B 750

UNIVERSITY OF GLASGOW

LECTURESHIPS IN MECHANICAL ENGINEERING

Applications are invited for three LECTURESHIPS IN MECHANICAL ENGINEERING, tenable from 1st October, 1960. Salary scale: £900-£1650 per annum. Initial salary according to experience and qualifications. F.S.S.U. and family allowance benefits.

Fields of teaching duties and research interests of those appointed will be as follows:

(i) Applied Mechanics, including either Automatic Control and Control Mechanisms, or Strength of Materials, or Vibrations.
(ii) Applied Thermodynamics.
(iii) Engineering Metallurgy and Properties of Engineering Materials (entirely new teaching duties).

New laboratories and equipment provide excellent research and teaching opportunities for all posts.

Applications (6 copies) should be lodged, not later than 15th May, 1960, with the undersigned, from whom further particulars may be obtained.

ROBT. T. HUTCHESON,
SECRETARY OF UNIVERSITY COURT. B 740

LANCHESTER COLLEGE OF TECHNOLOGY, COVENTRY

PRINCIPAL: A. J. RICHMOND, B.Sc. (Eng.) (Lond.), Ph.D., M.I.Mech.E.

Applications are invited for the following posts, duties to commence 1st September, 1960. This new College will offer advanced sandwich and full-time courses, H.N.C. and certain more advanced City and Guilds courses, as well as a range of professional courses in Commerce and Management Studies.

The departments of Mechanical and Production Engineering will be housed entirely in new buildings this summer, while the department of Electrical Engineering will have a limited number of new rooms, laboratories and new equipment until the whole of the building programme is completed.

DEPARTMENT OF MECHANICAL ENGINEERING

ONE SENIOR LECTURER to specialise in Applied Thermodynamics.

Candidates should normally be University graduates and Chartered Mechanical Engineers.

DEPARTMENT OF PRODUCTION ENGINEERING

ONE LECTURER
ONE ASSISTANT LECTURER GRADE B

Candidates for the Lectureship should normally be Corporate Members of the Institution of Production Engineers, while candidates for the Assistant Lectureship should normally have at least a good Higher National Certificate in Production Engineering.

DEPARTMENT OF ELECTRICAL ENGINEERING

2 SENIOR LECTURERS IN ELECTRONICS
ONE SENIOR LECTURER in Electrical Power (including Generation, Distribution, and Utilisation).

Candidates should normally be University graduates and Chartered Electrical Engineers.

Appropriate industrial or research experience is essential for all posts, while previous teaching experience would be an advantage, but is not essential.

Excellent facilities for research and development work will be available, and is encouraged by the Governors.

SALARIES (MEN)

SENIOR LECTURERS: £1550 by £50 to £1750 p.a.

LECTURER: £1370 by £35 (4) and £40 (1) to £1550 p.a.

In certain circumstances, candidates for the above grades may be paid a commencing salary above the minimum of the respective scales.

Assistant Lecturer Grade B: £700-£1150 plus additions at the minimum and maximum for training and graduate equivalent, which may amount to £285 p.a. Commencing salary depends on age and experience.

Women receive slightly less at present, but equal pay will apply from April, 1961.

Further particulars and application forms stating the post concerned may be obtained by sending a stamped addressed foolscap envelope to the REGISTRAR, LANCHESTER COLLEGE OF TECHNOLOGY, TEMPORARY ADDRESS, BUTTS, COVENTRY, to whom completed forms should be returned immediately.

W. L. CHINN,
Director of Education. B 780

JAMAICA COLLEGE OF ARTS, SCIENCE AND TECHNOLOGY, KINGSTON

(PRINCIPAL: H. FALKNER, M.Sc. (Wales), B.Sc. (Lond.), A.Inst.P.)

Applications are invited for ASSISTANT LECTURERS or LECTURERS in the following subjects:—

(*a*) MECHANICAL ENGINEERING:—Machine Shop Practice: Welding and Fitting; Automobile Practice.

(*b*) ELECTRICAL ENGINEERING:—Electrical Power and Distribution; Electronics and Light Current.

(*c*) CIVIL ENGINEERING:—Wood Machining, Carpentry and Joinery.

The work extends to H.N.C. or C. & G. final standard, and the appointments are due to the rapid expansion of the College.

Salary scales (at present under review):—

Assistant Lecturer: £735 by £30 to £915 by £40 to £1195 by £50 to £1250 p.a.

Lecturer: £955 by £40 to £1195 by £50 to £1445 p.a.

Entry point according to qualifications and experience.

Further information obtainable from COUNCIL FOR OVERSEAS COLLEGES, 12 LINCOLN'S INN FIELDS, LONDON, W.C.2, to whom applications (6 copies) giving age, qualifications, experience and names of 3 referees should be sent by 30th April, 1960. B 764

UNIVERSITY OF ST. ANDREWS

Applications are invited for a SENIOR LECTURESHIP or a LECTURESHIP in ELECTRICAL ENGINEERING in the Department of Electrical Engineering, Queen's College, Dundee, to commence 1st October, 1960. Candidates should be honours graduates in Electrical Engineering or Physics, and should have suitable research and teaching experience in electronics and radio communication. Salary scales (subject to upward revision): Senior Lectureship—£1725 by £75 to £2100 by £50 to £2150; Lecturer—£900 by £50 to £1350 by £75 to £1650 (efficiency bar £1350); F.S.S.U.; Family Allowance; Grant towards removal expenses. Applications (6 copies) containing the names of three referees, to the undernoted, from whom further particulars may be obtained, not later than 7th MAY, 1960.

PATRICK CUMMING,
JOINT CLERK TO THE UNIVERSITY COURT,
QUEEN'S COLLEGE, DUNDEE. B 765

APPOINTMENTS OPEN

MECHANICAL ENGINEER

EXPERIENCED MECHANICAL ENGINEER (with some slight experience of civil engineering as well) is wanted by local engineering company to take charge of workshops and manage an Engineering Division in the Persian Gulf. Free air passages, free air-conditioned accommodation, power, light and water. Home leave on full pay every other year.—BOX MA/RC 630, c/o 95, BISHOPSGATE, LONDON, E.C.2. B 751

DRAUGHTSMAN

Wanted for small drawing office designing plant, equipment and buildings for non-ferrous smelting and refining works in pleasant surroundings 8 miles west of Hull. H.N.C. and experience in design of chemical plant and structures desirable but not essential. Good salary for first class man.

Please write to CAPPER PASS AND SON LIMITED, MELTON WORKS, NORTH FERRIBY, YORKSHIRE. B 749

REPRESENTATIVES

REPRESENTATIVE wanted by Manchester firm of Gear Cutters to take over the Midland area, in which they are already well established, on commission basis. A good knowledge of gearing would be required.—Replies giving full details of past experience will be treated in confidence.—BOX B 746, Offices of ENGINEERING.

ENGINEER

A good opportunity occurs for an engineer, preferably a graduate, who has had some experience of print or printing machinery, and who is interested in the design of machinery for the printing trade. Apply:—BOX B 744, Offices of ENGINEERING.

CIVIL ENGINEERS

Applications are invited for the appointment of a SENIOR AND JUNIOR ENGINEER with previous experience in reinforced concrete design and construction.

These vacancies occur in design office for interesting and varied industrial work.

Apply quoting ref. : "SAR" to MERZ AND MCLELLAN, CARLIOL HOUSE, NEWCASTLE UPON TYNE 1. B 754

MAINTENANCE ENGINEER

GLASSHOUSE CROPS RESEARCH INSTITUTE requires MAINTENANCE ENGINEER, initially to carry out a major re-organisation of the glasshouse heating system, and thereafter be in charge of general engineering maintenance. O.N.C. or equivalent desirable, but practical ability essential. Appointment will be made in first instance within salary scale of Technical Works Class, Grade IV, (approx. £590-£727), point of entry depending on experience and ability; superannuation.—Further particulars obtainable from SECRETARY to the Institute, WORTHING ROAD, LITTLEHAMPTON, SUSSEX, to whom applications, together with names of two referees, should be addressed before 18th April. B 724

MAINTENANCE AND DEVELOPMENT ENGINEER

MAINTENANCE AND DEVELOPMENT ENGINEER required by HAWTHORN LESLIE (SHIPBUILDERS), LTD., HEBBURN UPON TYNE. Sound experience of plant installation and maintenance essential. Applications to General Manager giving age also particulars of training and experience. B 613

R.C. DETAILERS

CONSULTING ENGINEERS require R.C. DETAILERS; minimum three years experience. Permanent position. Pension scheme, luncheon vouchers.—Send details of experience and salary required to F. R. BULLEN & PARTNERS, DACRE HOUSE, DEAN FARRAR STREET, WESTMINSTER, S.W.1. B 703

REPRESENTATIVES

REPRESENTATIVES wanted for correspondence abroad, high earnings, written instructions.

Write: FORTUNA PUBLISHING CO., VIENNA 1/8, POSTFACH 40, AUSTRIA. G 824

MECHANICAL ENGINEER

Age 35-50, with experience of machine shop, power services and the maintenance and overhaul of heavy production plant. To operate in Cornwall and Devon. Staff appointment, contributory pension scheme.—Details of training, qualifications, experience and present salary, in confidence, to BOX B 774, Offices of ENGINEERING.

DEPUTY POWER STATION SUPERINTENDENT

Age 35-45, required for a privately-owned Power Station in Cornwall. Experience with water-tube boilers up to 500 p.s.i. and generating sets up to 10 MW essential. Staff appointment, contributory pension scheme. Car essential. Details of training, qualifications, experience and salary, in confidence, to BOX B 775, Offices of ENGINEERING.

WORK STUDY ENGINEER

Age about 30, required for large Company in St. Austell, Cornwall. Experience of engineering workshops, materials handling and production plant layout, with the ability to work with plant designers essential. Staff appointment, contributory pension scheme.—Details of training, qualifications, experience and present salary, in confidence, to BOX B 776, Offices of ENGINEERING.

DRAUGHTSMEN

Four required by Tyneside Power Station Contractors, able to work with minimum supervision and having experience in either (*a*) Electrical Diagrams, Cable Layouts or Signalling. (*b*) Plant Layouts, Steam and Feed Pipework, etc., or (*c*) Structural Steel and/or Reinforced Concrete.— Write fully in first instance to CHIEF DRAUGHTSMAN, BOX B 770, Offices of ENGINEERING.

MECHANICAL ENGINEER

required for Mechanical Development work in Research Department at Rickmansworth, of specialist Civil Engineering Company. The successful candidate would join a small team engaged on a wide variety of projects and would require a sound knowledge of basic engineering principles and the ability to apply them to the solution of real problems. Applicants should be of Graduate status and have completed a period of practical training, preferably including some design work. Previous research or development experience would be an advantage.

Salary according to qualifications and experience. 5-day week. Discretionary bonus. Contributory Pension Scheme.

Please write to:

THE PERSONNEL OFFICER,
THE CEMENTATION COMPANY LIMITED,
20 ALBERT EMBANKMENT, S.E.11.

B 766

MECHANICAL ENGINEER

Age 30-40, with experience of job and batch production and control, required for a medium sized Engineering Company in Cornwall with foundry, machine and structural shops. Staff appointment, contributory pension scheme. Details of training, qualifications, experience and present salary, in confidence, to BOX B 773, Offices of ENGINEERING.

BOILER ENGINEERS

BOILER ENGINEERS for commissioning and service work on latest type marine and land installations. Travelling involved. Required qualification is Ministry of Transport certificate or equivalent Naval ranking. Age range 25-40 years. Good conditions and prospects.—Apply in writing to STAFF MANAGER (T & S), FOSTER WHEELER LIMITED, 3, IXWORTH PLACE, S.W.3. B 730

DESIGN AND DETAIL DRAUGHTSMEN

Manufacturer in Southern England, producing precision components for the motor trade requires DESIGN AND DETAIL DRAUGHTSMEN, O.N.C. or H.N.C. preferred.—Write stating age, experience and present salary.—BOX B733, Offices of ENGINEERING.

Senior Experimental Engineer

A Deputy Chief Experimental Engineer is required to be responsible for prototype workshops and test laboratories engaged on research and development of mechanisms for the European Motor Industries.

The experimental work includes the conception and implementation of test procedures associated with small mechanisms, and their performance in vehicle bodies, determination of the behaviour of body structures under vibratory conditions, development of test equipment, endurance testing of mechanisms, etc.

Applicants should have a degree, or equivalent qualification, in Mechanical Engineering and experience in one or more of the branches indicated.

Development commitments have international scope and occasional journeys to the Continent will be necessary.

Working conditions are excellent and transport is available to and from the Laboratories.

The post carries monthly staff status, a competitive salary, staff Pension Scheme, etc.

Applications, which will be treated in strict confidence, should state age and full details of qualifications and experience and be addressed to:—

Chief Development Engineer,
Wilmot Breeden Laboratories,
Umberslade Park, Solihull, Warwickshire. B 727

WILMOT BREEDEN LABORATORIES

BELL HELICOPTER CORPORATION

•

BELL HELICOPTER CORPORATION

plans to add

SEVERAL TOP-CALIBER ROTARY WING ENGINEERING SPECIALISTS

We require men who have

EXTENSIVE HELICOPTER EXPERIENCE

and are capable of contributing substantially to our VTOL effort.

We have shown a steady growth since 1941 and are presently engaged in some long range programs which, with our continued research, ensure an excellent future.

Employment would include relocation to the FORT WORTH-DALLAS area in TEXAS where our modern plant is located.

If you feel that you qualify, please contact our British employment representative:-

Mr. J. SHAPIRO
265, FINCHLEY ROAD
LONDON, N.W.3

ERECTING ENGINEERS

required by

BABCOCK & WILCOX LTD

for
CONSTRUCTION
of
WATER TUBE BOILERS
and
AUXILIARY PLANT
in the
UNITED KINGDOM & OVERSEAS

Good prospects for experienced mechanical and steam plant Engineers.

Apply to:

Assistant Secretary,
209, Euston Road,
London, N.W.1. B 752

SENIOR DRAUGHTSMAN

required

for design of plant and layout for manufacture of investment-moulded steel castings. Should hold H.N.C. and have had experience in connection preferably with this type of process, or in steel foundry or other metallurgical plant, or chemical plant.—Applications, giving appropriate details of experience, should be sent to the

PERSONNEL OFFICER,
FAIREY AVIATION LIMITED,
HAYES, MIDDLESEX. B 738

PROGRESS ENGINEER

to direct orders and deliveries for Bridge Construction Contracts for LUTON office of DORMAN LONG (BRIDGE & ENG.) LTD. Experience in Structural and Civil Engineering Works and preparation certificates of payment desirable.

Salary based on experience and qualifications.

Apply with particulars, experience, etc., to:

DORMAN LONG (BRIDGE & ENG.) LTD.,
BRIDGE AND CONTRACTING DEPT.,
38/40, BUTE STREET, LUTON.

B 778

British Oxygen Gases Ltd.

have the following vacancies in their development group. The work is in connection with the development of equipment used in the medical field, for anaesthesia, oxygen therapy, resuscitation and automatic ventilation.

Development Engineer

Applicants should have a recognised technical qualification, preferably of pass degree or equivalent standard, as well as sound previous experience of design and development or experimental work in an appropriate direction. Familiarity with mechanical devices, scientific apparatus (not exclusively optical), instrumentation techniques, or systems involving the transfer of fluids would be an advantage.

Technical Assistant

Applicants should possess an O.N.C. or equivalent and have had some experience of test and experimental work of a nature parallel to that indicated above for the Development Engineer post.

APPLY IN WRITING TO PERSONNEL MANAGER,
British Oxygen Gases Ltd.,
SPENCER HOUSE, 27 ST. JAMES'S PLACE, LONDON, S.W.1.

B 735

MARKET RESEARCH ENGINEER

A challenging and rewarding opportunity presents itself for a Market Research Engineer who will complete the established development team of a Light Engineering Company currently producing a wide range of control instruments and ancillary equipment and now extending their activities into other fields.

This appointment calls for the keen and energetic but widely experienced services of a professional engineer who, together with a commercial flair, has a proven record of successful negotiations at the highest level.

The post is based in a South West Provincial Town but the person appointed will be required to spend most of his time in the field seeking and investigating new products.

The responsibilities will be great and the salary commensurate.

Applications, which will be treated in the strictest confidence, should give full particulars and be addressed to BOX B 768, Offices of ENGINEERING.

GKN

ELECTRICAL ENGINEERS

THE GROUP RESEARCH LABORATORY

requires Electrical Engineers to design and develop equipment for the control of automatic processes. This work will involve circuit design, instrumentation and the production of prototype equipment.

Posts are available at the Laboratory at Wolverhampton for:

1. A **GRADUATE ENGINEER** who is a qualified electrical or electronic engineer. He should have experience in modern electronic techniques, including the use of semi-conductors. Applicants should be between 25-30 years. (Ref. EE/1.)

3. An **ELECTRICAL ENGINEER,** qualified to H.N.C. or an equivalent standard, with considerable industrial experience. (Ref. EE/2.)

Applications, quoting the reference and giving details of career to date, age, salary, qualifications, etc., should be made to:

THE RECRUITMENT OFFICER,
G.K.N. GROUP RESEARCH LABORATORY,
BIRMINGHAM NEW ROAD,
LANESFIELD,
WOLVERHAMPTON.

B 747

THERMAL POWER PLANT DIVISION of the RESEARCH & DEVELOPMENT DEPARTMENT

Three interesting and progressive positions will shortly become available for which applications are invited.

SENIOR DEVELOPMENT ENGINEER
This job involves a thorough knowledge and experience in the design of boilers and ancillary plant for large power stations and applicants should have also had experience in heat transfer calculations and thermal design. Please quote: SDE/5.

SENIOR DESIGN DRAUGHTSMAN: whose work will consist of development of boilers and ancillary plant for Power Stations. This is an interesting position for a man who has had successful experience in this field. Please quote: SDD/5.

COMBUSTION ENGINEER: required to work on all aspects of combustion associated with the development of advanced steam boiler plant. The appointment will carry full responsibility for this aspect of steam boiler plant development and one of the duties will be to initiate and supervise research projects. Please quote: CE/5.

Successful applicants for each of these positions will be paid an excellent salary and will enjoy above-average working conditions including a non-contributory pension scheme.

Applications, which will be treated in strict confidence, should be sent to the Personnel Officer, giving fullest particulars of experience and qualifications.

CLARKE, CHAPMAN & CO., LTD.,
VICTORIA WORKS,
GATESHEAD-ON-TYNE.

B 779

STEELWORKS PROJECT ENGINEER

Applications are invited for the position of STEELWORKS PROJECT ENGINEER from men qualified in the layout and operation of Steelworks Plant and the co-ordination of requirements for Heavy Shears, Handling Equipment and Ancillary Gear, etc.

Applicants should be able to guide general designs to meet specifications and supervise the manufacture of building of complete equipments.

The opening offers excellent prospects for a man of proved ability.

Please write, giving full particulars of age, training and experience, to BOX B 762, Offices of ENGINEERING.

CIVIL ENGINEERS

CONSULTING ENGINEERS have vacancies in their London Office for QUALIFIED CIVIL ENGINEERS, preferably with structural experience for design work.—Apply stating age, salary required and full details of experience, to "EN" LIVESEY & HENDERSON, 1/2 FINSBURY SQUARE, LONDON, E.C.2. B 761

EDITORIAL ASSISTANT

EDITORIAL ASSISTANT required for monthly journal specialising in world hydro-electric development. Should be young engineer (25-35), with qualifications and experience, preferably in civil or hydraulic engineering or in laboratory work. Aptitude for technical writing essential. Some knowledge of languages an advantage. Prospects of eventual editorship for the right candidate.—Apply: THE EDITOR, "WATER POWER," 33 TOTHILL STREET, S.W.1. B 760

ASSISTANT ENGINEER

UNILEVER LIMITED invite applications for the post of ASSISTANT ENGINEER in the Fuel and Steam Section of their Mechanical Engineering Department in their London Headquarters.

Applicants for this post should be Corporate Members of one of the senior Institutions and/or hold equivalent qualifications. They should have had substantial general experience in the use and generation of steam and should, for preference, have specialised experience in at least two of the following subjects:—

(*a*) FUEL COMBUSTION
(*b*) HEATING AND VENTILATION
(*c*) BOILER CONSTRUCTION AND OPERATION
(*d*) STEAM UTILISATION.

Written applications, with a note of training and experience, should be sent to HEAD OFFICE, STAFF DEPARTMENT (WF 54), UNILEVER HOUSE, BLACKFRIARS, LONDON, E.C.4. B 748

APPOINTMENTS WANTED

EXPERIENCED STAFF AVAILABLE

EXPERIENCED STAFF for hire in all branches of engineering.—Please phone AMB 8189. B 591

DESIGNER/RESEARCH ENGINEER

ROTARY ENGINES. Designer/Research Engineer available from mid-June to work on this subject for an organisation genuinely interested in producing a British engine. All replies treated in strict confidence.—BOX B 769, Offices of ENGINEERING.

'Engineering' Appointments Section
ADVERTISEMENT RATES

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.
TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates per page: (12 in. by 9 in.)	£100
half page	£54
quarter page	£29

(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

Rates: per page (12 in. by 9 in.)	£100
half page	£54
quarter page	£29
single column inch	£2 14s.

(c) Single column "run-on" advertisements: approximately 6 words to the line, 12 lines to the inch

Rate per line (Minimum charge 18s.)	4s. 6d.

SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13; 15 per cent. on 26.
BOX NUMBER: 2s.

COPY DATE: First post Monday.
BLOCKS: To be mounted ready for printing. Screen 100.
ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2. (Telephone TEMple Bar 3663)

Companies

AEI Cable Contracts for Kent Rail Job Complete

ASSOCIATED ELECTRICAL INDUSTRIES CONSTRUCTION (CABLES AND LINES) DIVISION has now completed stage one of the first phase of the electrification of the Southern Region's lines to the Kent coast.

The contracts involved included a £750,000 HENLEY undertaking for the 33 kV three-core oil-filled cable and multicore pilot-supervisory cable, a similarly valued contract by SIEMENS EDISON SWAN for signalling cables and the supply by Siemens of large amounts of various cables to the SIEMENS AND GENERAL ELECTRIC RAILWAY SIGNAL Company.

Last and most involved of the work was at the new Kingsferry Bridge across the River Swale to the Isle of Sheppey in the Thames estuary.

Problems arose here since the bridge has a steel lifting span carrying a single rail track and double roadway. Cables for the rail electrification have been taken down shafts inside the main bridge piers and through a tunnel driven under the river bed between the piers.

Handling the heavy power cables in the restricted space presented difficulties, particularly as the efforts of the hauling teams at either side of the lift span had to be synchronised. A public address system was put in to carry the foreman's instructions to all parts of the scene.

The handling of the long length of heavy wire armoured oil-filled cable up and down the shafts was especially awkward and considerable weight was at times being managed by the cable-laying gang.

Refrigerator Air Lift to the United States

If there is a more difficult place to sell refrigerators than in Lapland it must be in the American market against the competition of the native United States manufacturers.

MORPHY-RICHARDS are doing just this, with their "Astral" small-sized refrigerators. American refrigerator makers have not got round to compacts and the British firm has been able to step into a market with many branches of demand for a refrigerator that does not take up the space of a sentry box.

Only last month the company hired a KLM Super-Constellation and flew 350 refrigerators (weighing 14½ tons) to New York. Two types were sent over, one operating on bottled gas, the other on electricity.

The market in the States for the smaller refrigerator extends all the way from the caravan and the boat to the office, the factory, the living room and the hospital. Since there are seven million Americans living in trailer homes, "caravans" on the Eastern side of the Atlantic, the prospects for Morphy-Richards appear bright.

At Dundee a new Morphy-Richards Astral factory should be ready for the move-in towards the end of the year. It will have a production floor area of 340,000 sq. ft and will add substantially to the capacity for the production of the dollar-earning new Astral table model whose first consignment was so enthusiastically air-lifted.

The Golden West for British Exports

The British manufacturer exporting to the west coast of the United States has lower transport costs than his competitor manufacturing on the American east coast. This startling fact, due to the low cost of British shipping compared with United States' freight charges and rail costs, is being made known to thousands of British companies by the DOLLAR EXPORTS COUNCIL booklet "The New West."

The greater part of the booklet is taken up with the London Week which aroused enthusiasm in San Francisco last October. Is the stimulus which that resounding publicity provided being followed through by United Kingdom manufacturers?

Mr. H. S. Marchant, the British consul general in San Francisco, wrote to Lord Rootes, chairman of the Dollar Exports Council, "All this local publicity and goodwill is fine as far as it goes, but you may well ask how much, if anything, 'London Week' has achieved in trade promotion. The answer is, I believe, 'something, but not enough'—for the simple reason that there is still no great variety and quantity of British goods out here."

That the 11 western states of America are an important market now and will become even more so is shown by the rising population and its wealth. From 20 million in the western states nine years ago the population has risen to 26 million, and by 1970 it is expected to have reached 34,500,000. The effective yearly buying income of the Western states averaged $1,926 a head in 1958, against a national average of $1,750.

Speed of economic development in the 11 states—New Mexico, Colorado, Washington, Montana, Oregon, Nevada, Utah, Idaho, Wyoming, Arizona and California—has been rapid. Their industrial employment increased by 45 per cent since 1950. The United States as a whole by only 3 per cent.

Aircraft, electronics and motion pictures are the best known of the west coast industries—though Hollywood, which put Los Angeles on the industrial map, now only employs 1·2 per cent of the city's labour.

California is now the first state in the Union for food processing, second for car production and the output of petroleum products.

The future will see even sharper competition from European and Japanese firms. As the Dollar Exports Council emphasises, this is very much the time for British exporters to be making an effort to get into the Golden West.

But the Council itself needs to catch some of the pace and directness of these successful west coast Americans. Their booklet, colourful and informative, opens with the discouraging words—"A little less than a hundred years ago. . . ."

Competition Among Crane Makers

A British company which has found itself being consistently asked for much shorter delivery dates is CLYDE CRANE & BOOTH Limited, West St., Gateshead. Their annual report shows that despite increasingly keen competition in the crane industry the trading profit was raised by almost 25 per cent.

Mr. J. B. Woodeson, chairman of the company, reported that the majority of the year's output was of overhead and dockside cranes and that a fair proportion had been of more than 100 tons capacity.

While both the drawing office and the works have been adjusting to meet the demands of the shorter delivery orders the particular specifications of design required by a number of customers were successfully met. In order to meet the growing needs of special crane design a new office block for technical staff is to be built.

The 1960 order book is full, but more orders are needed to keep the works fully engaged in 1961. On this point Mr. Woodeson said he had every confidence that with the shorter delivery now being demanded this position would soon put itself right.

New Company Grows from Peace River Project

INTERNATIONAL POWER AND ENGINEERING CONSULTANTS, of Vancouver, Canada, is a new company that has developed from the power consulting organisation that was set up in 1958 to execute the engineering work on the

British Columbia Peace River hydro-electric scheme.

The former organisation was BC AND BB POWER CONSULTANTS, in which BALFOUR BEATTY AND COMPANY, of London, had a 49 per cent interest, while the remainder was held by the BRITISH COLUMBIA POWER CORPORATION through its subsidiary BRITISH COLUMBIA ENGINEERING COMPANY.

The new firm will be owned by BCP and Balfour Beatty equally.

The chairman is to be Sir Andrew MacTaggart (inset) chairman of BB and of the PEACE RIVER POWER DEVELOPMENT Company. The aim of International Power and Engineering Consultants will be to enlarge its field of operations through British Columbia and Canada to overseas contracts.

Less Bread but more Houses

Improvement in demand has made it possible for the engineering and machinery manufacturers THOMAS ROBINSON & SON to return in the last months of the last financial year to full production, but shortage of skilled labour has imposed some restriction.

In both home and overseas markets the increased demand everywhere requires short delivery dates and Mr. J. C. Robinson, chairman of Thomas Robinson, says in his annual report that a return to the extended order book of some years ago is "most unlikely."

The improvement of late last year was too delayed for a full recovery in the firm's performance and only the reduced demands of taxation enabled it to end with a slightly higher net profit.

The generally higher standard of living in the United Kingdom has as one of its side effects a reduction, compared with the immediate post-war years, in the consumption of both potatoes and bread. The decreased demand for flour has closed numbers of mills but those remaining have to modernise and Robinson's flour milling machinery division has executed a number of remodelling projects using the company's machinery and equipment.

The woodworking machinery division benefited from the effect on the building industry of last year's summer and the increased investment in private house building.

Nickel at Record Heights

The nickel producers of the world, apart from Soviet bloc countries, delivered 515,000,000 lb of nickel in 1959, a substantial advance on their former figures.

Consumption was also running at new levels, 420 million lb, against the previous best of 415 million in 1957.

The adverse effect of the steel strike in the United States where demand was growing stronger was to a large extent cancelled out by marked improvements in use in Britain and other European industrial markets.

These facts, given in the annual report of the INTERNATIONAL NICKEL Company of Canada, are the background to the firm's own record year. For the first time in its history International Nickel delivered more than 300 million lb of nickel in a year. This was immediately after deliveries in 1958 had collapsed to the lowest level for more than ten years.

The last three years of the company's deliveries were: 1959, 317,040,000 lb, 1958, 210,570,000, 1957, 280,810,000. In copper deliveries the company has strongly recovered from the low level of 1958 but was still 28 million tons short of 1957's copper delivery of 280 million tons.

Thompson Mine

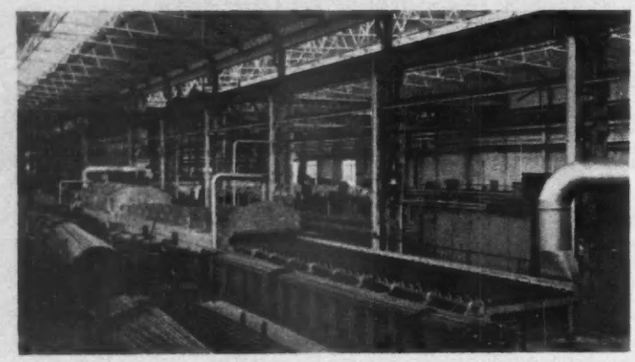
In the stainless steel and nickel plating firms the greatest interest in International Nickel's report may well be attracted to the progress report on the Thompson mine, Manitoba, which is intended eventually to add a capacity of 75 million lb of nickel a year to the company's resources. Preparatory mining, milling, and smelting operations are due to be begun in the last half of the year and refining operations early in 1961. Two-thirds of the £27 million spent on capital account last year went into the Thompson mine.

In the research department, the company has now produced a series of high strength nickel alloy steels containing 20 to 30 per cent nickel. These have a wide range of uses from machine parts to large pressure vessels and other heavy equipment.

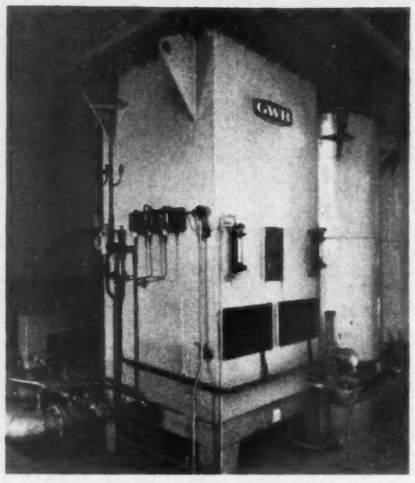
With other copper producers International Nickel joined in the setting up of a Copper Products Development Association whose task is to find new markets for copper and copper alloys.

Annealing Tubes in a Roller Hearth Furnace

The accompanying illustration shows the latest of a series of three similar electric roller hearth furnaces to be installed at Yorkshire Imperial Metals Limited of Leeds. The furnace which was designed and installed by GWB Furnaces of Dudley is now in operation. It will be used for bright-annealing copper and annealing brass tubes of most analyses in straight lengths and copper tube in coils. Tubes in straight lengths up to 35 ft, from ¼ in outside diameter by 20 s.w.g. to 4 in outside diameter by ¼ in thick, and coils 5 ft 9 in outside diameter by 6 in high, weighing 150 lb, may be treated. By using extensions, conical tanker tubes 80 ft long have been treated. When annealing straight tubes, outputs of 2·85 tons of copper housing tube and 2·87 tons of brass tank heater tubing have been obtained in one hour.



(*Left*) *An end view of the 166 ft long roller hearth furnace.*



(*Right*) *The protective atmosphere generator.*

The equipment has an electrical rating of 550 kW which is supplied to four automatically controlled zones. The heating elements in each zone are fed through tapped transformers to give reduced ratings when lower temperatures are needed or when the charge is light.

The 25 ft long heating chamber can accommodate charges up to 9 in high and 6½ ft side. A water jacketed cooling chamber 50 ft long is fitted at the exit end of the heating zone and discharge vestibule so that the charge can be cooled gradually. To obtain the correct degree of heat balance from one end of the unit to the other, and to provide a gas seal when feeding coils, an entry zone 13½ ft long is provided. The internal rollers are all power driven. All rollers are 4½ in outside diameter and flanged for locating the charge; those in the heating and cooling chambers are of heat resisting material, while the remainder are of mild steel. Rollers on the loading and unloading tables, together with those in the furnace vestibule are set at a wider pitch than those in the heating and cooling chambers where maximum support of the charge at high temperatures are required. Again, to cut down atmosphere losses, a section of high speed charging rollers is arranged on the loading table and the first portion of the entrance chamber. Also, to cater for the different charge characteristics, a Carter infinitely variable hydraulic gear box allows the roller speed to be adjusted from 6 in to 6 ft per min. External self-aligning bearings support the rollers—a special type being used where they undergo high temperatures. If necessary, roller may be withdrawn through the side of the furnace, with a minimum of delay in operation. The gas-tight roof is removable in sections for internal maintenance.

The protective atmosphere, when required, is supplied from a GWB burnt town gas plant. Air and gas are mixed by a Selas mixer, the proportions being adjustable to obtain the right carbon monoxide to carbon dioxide ratio for the metal being processed. The mixture is ignited in combustion chambers lined with refractory material and water cooled. The gases then pass through two scrubbers where they are cooled and cleared of tar particles by means of water spraying on to small coke. Before the gas is fed into the furnace, sulphur is extracted in two purifiers containing bog iron ore and activated carbon.

The heat treatment of a wide range of tubes calls for a high degree of temperature control and this is provided automatically by means of a GWB control cubicle. Four Kent Multelec indicating controllers are fitted, one for each zone, and a four-point recording instrument allows a visual check to be made during any part of the process cycle. In the event of accidental overheating, safety contacts cut off the supply to the heating elements.

Handling Aluminium Swarf

Berk Exothermics Ltd., Portman Sq., London, W1, have installed a handling, storage and sifting plant for the manufacture of exothermic compounds. These compounds are for risers used in the foundry industry and their manufacture in Britain is comparatively new. The comprehensive plant is for aluminium swarf which is the primary material used in the manufacture of the compounds. The swarf used includes dressings, grindings and dross from the producers of castings and powdered refined aluminium. The plant was supplied by Thomas Robinson and Son of Rochdale.

The swarf is fed to the plant from outside the building via a hopper equipped with a dust extracting canopy coupled to the main exhaust system. Conveyance of the swarf to a Robinson Rexman screening machine is accomplished at a rate of 5 tons an hour by a bucket elevator.

The screening machine has a totally enclosed leakproof sieve securely clamped in a steel frame. This sieve frame is driven from the feed end by a gearless mechanism which, by means of special carrying rods supporting the sieve frame, imparts a rotary action at the feed end and a reciprocating action at the tail end. Rubber ball cleaners are fitted below the sieve and keep the cover free from obstruction and operating at maximum efficiency. Two separations are effected by the machine installed. They are the throughs of 16's wire mesh (1·24 mm aperture) and the rejects which fall by gravity spouting to a 2 ton capacity rejects bin for out-loading.

A further elevator is used to convey the throughs of the screening machine to a worm conveyor mounted above six 10 ton steel storage bins where the swarf is deposited in the right bin according to ist aluminium content. All delivery slides fitted below the worm conveyor used for depositing the swarf into the bins are controlled by chains from the ground floor.

The gravity discharge of swarf from the storage bins to the worm conveyor beneath is controlled by adjustable slides fitted to the connecting spouts. Discharge from the bin is effected at the rate of 3 tons an hour, the conveyor delivering to a further elevator which feeds a Robinson Minisifter.

The Minisifter is a compact machine occupying a floor area of only 4 ft by 4 ft, but with a sifting area of 54 sq. ft. It has a stack of six leakproof sieves, clamped to a base and gyrated in a 2 in circle at 250 r.p.m. Three mesh size products are produced by this machine. They are the swarf which will not pass through 40's wire mesh (0·503 mm aperture), swarf which will not pass 70's wire mesh (0·261 mm) and the swarf which does pass through the 70's wire mesh. The swarf in these three categories is allowed to flow by gravity spouting to portable metal containers, each holding 100 lb of swarf. To facilitate easy identification of the mesh size of the swarf, coloured tags are attached to each container as they are filled. The containers are then placed on a pallet and stacked by fork lift.

Aluminium swarf, iron oxide, dextrine and other chemicals used in the manufacture of the compounds are mixed in a 5 ton batch mixer for two hours and a number of laboratory tests are made before the compound is passed for packing.

All motors within the plant are flameproofed and are started from control panels in an adjacent building. They cannot be started until the warning horn has been sounded for a period of 15 seconds. A further delay of 45 seconds occurs before the first motor can be operated, and the sequence commences with the Minisifter at the delivery end of the plant. This ensures that all machinery is operating before swarf begins to enter the plant.

Forging Automatically to a Programme

A recent demonstration of the completely automatic forging of steel by pre-calculated programme is believed to be the first time this has been done anywhere in the world. The successful demonstration took place on the experimental forge belonging to the British Iron and Steel Research Association in Sheffield.

The forging was carried out by a precision

BISRA's automatic forging equipment.

controlled 200 ton press interlocked with a fast, remote-controlled, experimental manipulator capable of longitudinal, rotational and lifting movements. Electric controls had been developed for both press and manipulator to ensure fast, accurate operation and to synchronise the movements of the two machines. During the forging, the press and manipulator were controlled by a programme control unit on which every detail of the schedule of forging operations had been set up. In this schedule, the upper and lower limit of the squeeze for every pass were given, the manipulator feed between strokes was selected and the manipulation between passes was also stored. The control unit signalled instructions to the press and manipulator in the appropriate sequence.

The resultant forging, in some respects, exceeded the best current industrial standards as regards dimensional precision, and, in addition, the job was finished in half the time that would be taken by a highly skilled forging crew. Even faster working will soon be practicable.

The forging schedule was calculated in advance from a theory of change of shape during forging which had been worked out in the laboratory.

This advance in forging technique comes when many firms are already planning to re-equip their forges, in some cases to replace machines dating back to the beginning of the century. At the moment, there are probably more forging presses on order in this country than at any previous time; this development of automatic working therefore offers the forging industry a great opportunity to place itself ahead of foreign competition.

Automatic Production and Control Course

The Economics and Production Department of the College of Aeronautics at Cranfield, Beds., are running a two week course on automatic production and control this summer. It will last from 11 July to 22 July. The organisers aim to provide a general introduction into the field of automatic control, with particular reference to machine tools.

The course is intended for production engineers, planning engineers, production development engineers and similar junior executive staff.

Following an introductory lecture dealing with the underlying philosophy, it is intended to consider the basic theory of open and closed loop systems and the behaviour of these systems as applied in the field of automatic production. Several lectures will then be given on the different components which go to make up a complete system including such things as methods of measuring changes and actuating the movements of tools and slides. The lectures will be accompanied by demonstrations, and laboratory operation and testing of the different components dealt with in the lectures.

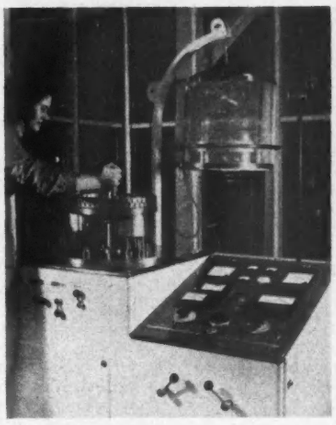
The second week of the course deals with the application of automatic controls to machining processes and machine tools with actual operations under test in the laboratory.

Finally, to round off the course, management aspects are to be considered along with the problems of product design and maintenance and servicing.

Further details about the course can be obtained from the Head of Department.

Making Metal Film Resistors

The Plessey Company Limited have set up a production unit at their Kembrey Street, Swindon, factory for the manufacture of Metallux resistors. This follows the announcement of an agreement between Plessey and Elettronica Metal Lux s.p.a. of Italy.



Ceramic formers being loaded into a vacuum deposition machine during the manufacture of Metallux resistors.

Metallux resistors are made up from a nickel-chrome alloy vacuum deposited on to a ceramic former. The stability, noise, temperature coefficient and voltage coefficient characteristics of the resistors are claimed to be distinctly better than those of conventional fixed resistors.

Ceramic formers are received complete with silvered ends ready for production. They are assembled on spools, put into a special carrier (magazine) and loaded on to the metallising machine. Between 100 and 700 resistors can be treated at once depending on the size of the former. The carrier holding the formers is placed in a chamber which can be evacuated to 10^{-4} mm of mercury by means of an oil diffusing pump. Four evaporation sources—equally spaced below the carriage—are heated at the correct sequence times and alloy deposited on the formers. Masks between sources and formers ensure even distribution of the metal film.

When the deposition process has been completed—it takes about an hour—each resistor is given a protective coating of silicone varnish. Metallised resistors are then placed on wire carriers and stabilised at a high temperature before being allowed to cool and batch testing to establish their temperature coefficient. The resistance is checked while a heated metal shroud brings the resistor to a temperature of 85° C. Individual resistors are then measured for ohmic value. This resistance value is known as the pre-value, and resistors are segregated according to their pre-value and temperature coefficient.

The final value of the resistor is obtained by grinding a spiral groove through the protective coating and metal film. The resistance is continually measured during grinding, and the operator stops the machine as soon as the correct value has been reached.

After grinding, wire terminals are added to the resistor elements. A machine is used which crops the wire from the spool, joggles the end and inserts it into the hole in the former. The joggle retains the wire in place by friction until solder has been applied to the wire and the silvered ends of the ceramic former. Final processing, dependent on the type of resistor required, is usually one of three main methods of treatment—paint protection, ceramic covering and epoxy resin encapsulation.

Cleanliness and Precision

The increasingly high standards of cleanliness demanded by new equipment has led the Sperry Gyroscope Company to add a new "super-clean" area to their existing clean room facilities at their Brentford, Middlesex, factory.

The first components to be assembled in their new super-clean area are the CL11 Rotorace Gyros, offering a random drift rate claimed to be at least ten times better than typical gyro compasses in standard airline use today (the random drift rate of a gyro is the effect of errors in the gyro including friction in the gimbals and out of balance in the rotating parts).

Clean air, filtered to exclude particles of the order of two or three microns, is fed into an area of approximately 500 sq. ft through roof ducts at a steady positive pressure, outgoing air passing through wall louvres at chest height. Temperature is controlled to within $\pm 2°$ F, and relative humidity to an upper limit of 40 per cent. Air recirculates every six minutes, and a complete air change takes place every quarter of an hour.

Employees working in the area remove their outer clothes in a changing room before passing into an inner sanctum where they can wash and don a white nylon suit, nylon boots and a nylon cap which they have to wear while working in the area.

Gyro assembly in super-clean working conditions.

Strict discipline is imposed to avoid any dirt generating operation. A clear vision panel is situated adjacent to the section leader's work table so that components and drawings can be examined from outside the area. Discussion is conducted by means of a voice intercommunication system, using one of two speaker control panels let into the inside walls of the area.

Traffic Requirements Control the Lights

Vehicle-actuated traffic lights have been used for many years, but present traffic conditions have necessitated a complete reappraisal of the control systems. New designs provide greatly increased flexibility.

The original vehicle-actuated traffic signals provided automatic control at straightforward two phase junctions; three and four phase and more complex controllers were developed as traffic engineers gained experience. This process of development has now been carried further by the introduction of a new control system, designed by the Automatic Telephone and Electric Company Limited, Liverpool, 7.

A signal installation should provide one or more of the following features; orderly movement of traffic, reduction of certain types of accident, progressive movement through a series of intersections, speed control on a main road, and periodic interruption of heavy traffic to allow pedestrians or vehicles to cross. To meet these requirements the system should have a capacity in excess of its loading, a phasing system flexible enough to provide minimum delay in heavy or light traffic conditions or at any degree of traffic density in between the extremes, and have a high factor of safety. The signal installation must also inspire confidence in drivers and pedestrians, a condition which is met by clear, well sited signals and by reasonable protection from conflicting movements. In addition, it may be necessary to provide for the linking of the signals at two or more road intersections. This establishes a definite relationship between the appearance of phases at the intersection so that their mutual interference is at a minimum, and vehicles can progress steadily past the complete series of signals. It is with all these varied requirements, and others of less frequent application, in mind, that the new controller has been designed by the ATE company.

Two, three and four phase controllers, alike in general construction, are available. They employ low voltage electronic timers and Post Office type relays, and provision is made in the design for adjusting the control facilities provided to suit many different local needs.

Normally, the right of way does not change from one phase to another unless a demand for a "go" signal has been registered by a vehicle passing over the appropriate detector. In other words, in the absence of traffic the signals remain in the condition last used. There are, however, certain exceptions to this rule to suit special circumstances. Normally, the right of way to a phase can be terminated (*a*) at the expiry of the minimum green period, (*b*) on the termination of a vehicle extension period, or (*c*) at the end of the maximum green period.

KEEPING ALL ROUTES MOVING

On controllers with three or more phases the right of way is given to each of the phases in accordance with a predetermined cycle when traffic is continuous on all approaches. In the absence of demand from a particular approach that phase is omitted automatically.

Whenever a right of way is given, there is traffic waiting for it, and this will be granted a minimum green period, whatever the traffic conditions may be. This period is not of fixed duration, but depends upon the number of vehicles waiting between the stop line and the detector when the period commences. Four ranges of setting for this period are available. If only one vehicle is waiting, it will be given a green light for 8 or 10 sec, as pre-set. If there are several vehicles this basic minimum green is increased progressively up to a limit of 15 sec. This increase can be set at a high or low rate. Under operational conditions the automatic variation of the minimum green period has the effect of reducing the cycle times during light traffic periods, thus achieving a fast turnover from one approach to another without reducing the safety margin. Provision is made for setting any phase to give fixed duration minimum green if required. Fig. 1 shows the variation available in the minimum green period.

Once the minimum green period has started, every vehicle crossing a detector in the relevant approach sets an extension time for itself in the accepted manner. This extension can be either of fixed duration or speed-timed according to the time which the vehicle wheel takes to cross the two channels of the detector. When speed-timed, the extension permits the vehicle to travel a sufficient distance to clear the junction safely before the lights change.

Maximum green follows the established pattern, in that it commences at any time during a running phase if a demand exists for passage from another phase, or is created by the arrival of a vehicle. There is, nowever, one new feature associated with the variable minimum green, in that a maximum termination impresses a full 15 sec minimum for the next appearance of the phase in question.

Between the end of the green period of one phase and the beginning of the green of the following phase there is an inter-green period. This can be adjusted to operate in the range 4 to 12 sec. A 4 sec inter-green period is made up of 3 sec amber-leaving and 2 sec red-amber, the last second of the amber and the first second of the red-amber running concurrently, as shown in Fig. 2. This ensures that a red signal is shown to the halting phase before the opening one is cleared by a green signal. When the inter-green period exceeds 5 sec (3 sec amber-leaving and 2 sec red-amber) the remainder of the inter-green period appears as an all-red indication sandwiched between the amber-leaving and the red-amber. This is also shown in Fig. 2.

As so far described, the inter-green period is based on pre-set timing. It is known as minimum inter-green and would, in practice, be set to provide adequate clearance time for fluid traffic conditions. Under heavy traffic conditions, however, it may be necessary to give a

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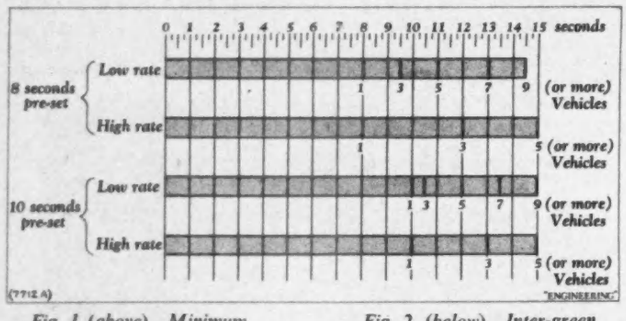
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8 seconds pre-set
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1 3 5 7 9 (or more) Vehicles
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Fig. 1 (above) Minimum green period.

Fig. 2 (below) Inter-green period (minimum).

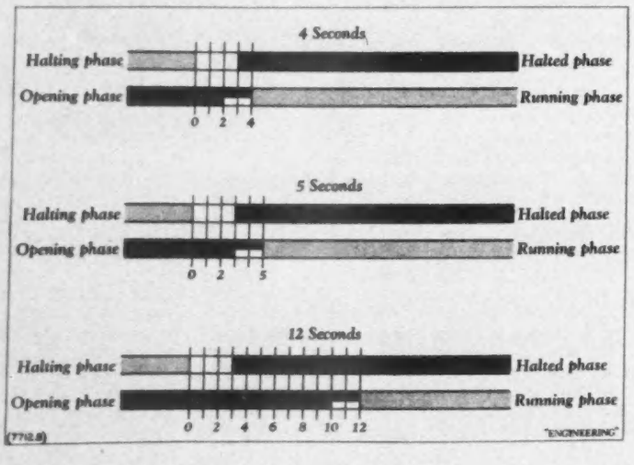
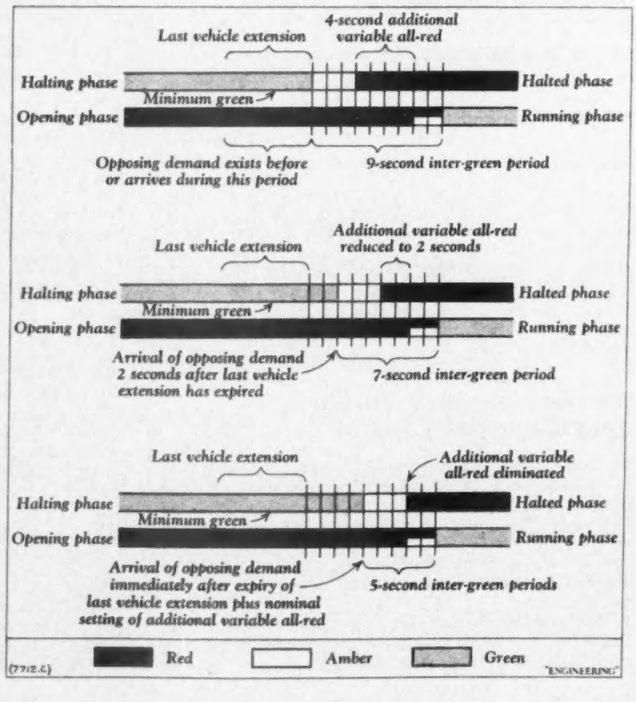


Fig. 3 (below right) Variable inter-green period. Based on a 5-sec. minimum inter-green and 4-sec additional variable all-red.

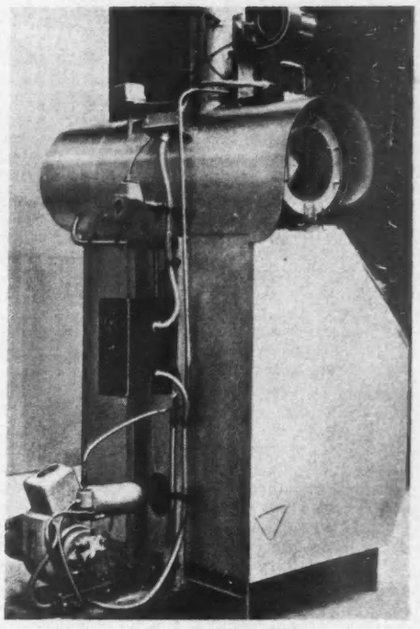


Waste Burnt Without Smoke

All factories have to deal with the problem of disposing of inflammable waste materials, and an incinerator is the usual answer. Many wastes, however, are particularly effective producers of smoke, which cannot be tolerated in these days. To solve this second problem, the Boston Marine and General Engineering Company Limited, Deans Road, Wolverhampton, have introduced the Hoskinson incinerator, which will burn any kind of inflammable wastes, including rubber, plastics, leather cuttings or paint in cans, without smoke or smell.

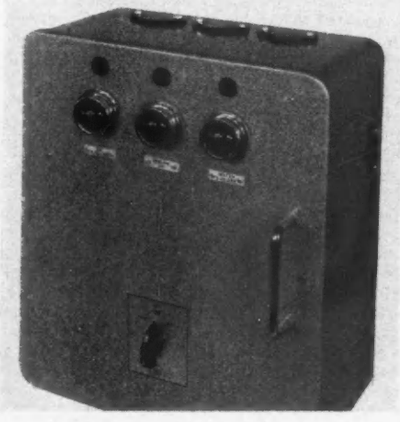
Of American origin, the Hoskinson incinerator is made by Boston Marine for the United Kingdom, European and other overseas territories, and arrangements have been made to export it to the USA. It consists of an incinerator chamber with a large charging door, capable of accepting, for instance, a complete motor tyre. At the base of the chimney leading from the incinerator is a small oil burner, consuming about half a gallon per hour, and a forced draught fan. The air from the fan passes through a special diffuser and supports the combustion of the ignition oil flame which, together with the air, enters the chimney to mix with the smoke from the burning waste. The base of the chimney consists of two concentric cylinders, and the annular space between them acts as an air heater. Heated air from the annulus passes into the chimney above the oil burner and ensures complete combustion.

Rubbish can be burnt at a rate of up to 300 lb per hour, and the heat can be used for space heating by means of a heat exchanger and fan on top of the incinerator chamber. To enable space heating to be continued at times when there is no inflammable rubbish available, an automatic oil burner is fitted at the base of the chamber. This burner is mounted on rails on the floor, and when it is needed is pushed into position; it changes the electrical circuit automatically to enable the incinerator to run as an oil fired space heater. When waste is available, the burner is retracted, and the mechanism changes over automatically, bringing the chimney burner into operation again. Both burners have flame failure protection and automatic ignition.



(Right) Rubbish can be burnt smokelessly in this combined incinerator and space heater. When there is no rubbish available, an oil burner is brought into use.

Diesel Engine Running Safeguards



A range of diesel engine protection panels, introduced by the special products department of AEI Radio and Electronic Components Division, 155 Charing Cross Road, London, WC2, gives immediate visual and audible warning of failure in lubrication and cooling systems and, if required, subsequent shut down. The equipment ranges from panels having two alarm or two shut down circuits to types providing either four alarm, four shut down, or three alarm plus three shut down circuits, with variants between these extremes. It includes main panels for use in single engine installations, or for the first or main engine in a multiple set. Extension units provide protection for all the engines except the main one in a multi-engine installation. A panel can be provided to indicate overspeed running and to shut down the engine if this occurs, and a test circuit allows for checking the various warning lamps and indicators. A cancellation circuit allows the audible warning to be shut off while a fault is being remedied. Various combinations of circuit can be supplied to suit a user's requirements, and the panels can be mounted in any position, remote from the engine and engine controls if necessary.

The panels are available for operation from a.c. or d.c., the a.c. models being made for any medium voltage supply. Direct current panels can be provided for any supply between 12 and 250 V. Main panels for d.c. operation comprise protection equipment, a main switch and a fuse. For a.c. supply, a main switch, fuses, transformer and, in some cases, a rectifier to provide d.c. for the shut down solenoid, are fitted in addition to the actual protection circuits. Extension units can be mounted, alongside or remote from the main panels, from which they take their supply. They carry protection circuits only.

(Left) One of a range of AEI equipment, this protection panel gives audible and visible warning of water or oil failure on a diesel engine.

Concluding **Traffic Requirements Control the Lights**

longer clearance period for such purposes as allowing vehicles which wish to turn right and have had to halt in the centre of the intersection, to get away. Such conditions are catered for by means of a variable inter-green period, which consists of an all-red signal inserted into the inter-green. This all-red signal is of pre-set nominal duration, but is varied automatically according to traffic conditions. Thus, the whole of the pre-set all-red period would be inserted if a demand for the next phase exists, or is made before the termination of a current vehicle extension period on the running phase. On the other hand, if the demand is made after the expiry of the last vehicle extension period, the additional all-red period is reduced proportionately. The operation of the variable inter-green period is shown in Fig. 3.

An access door in the controller enables a police officer to select fully automatic working, fixed-time working or manual control to deal with special traffic conditions. Under manual control with three or more phases, the right of way can be switched by push-button from phase to phase in any sequence. Such control can, however, only come into operation after a current minimum green or pre-set clearance period has expired. Provision is also made for the lights to be switched off without interfering with the operation of the controller; this allows a controller to remain in synchronism with others in a group, and permits a maintenance engineer to work the controller without displaying signals.

PASSING EMERGENCY TRAFFIC

To deal with special circumstances at a particular intersection, the controller can be made to operate under simulated continuous demand on any selected phase. This would cater for the breakdown of a detector, or allow for road works which prevented vehicles from operating the detector. Pedestrian phases can be incorporated, either on an automatic basis or by push-button operated by the pedestrians themselves, and green filter signals can be operated on one or more phases as required. Various other operating combinations are possible, all based on the standard controller.

A practical example of the versatility of the equipment is provided by the first set to be installed, which is at a busy junction in Liverpool. It controls a four-way intersection, for which a two phase controller would normally suffice. In fact, the installation is of the three phase type, with the third phase held in reserve to provide priority for fire appliances leaving a fire station near to the road intersection. In case of emergency the fire station duty officer "calls" the third phase by remote control, and receives audible and visible acknowledgement that the call has been received. The automatic controller then transfers the right of way to the third phase immediately after the expiry of the current minimum green, or at once if the minimum green has expired, giving priority to the road from the fire station, regardless of other traffic demands.

Acknowledgement is made to Mr. E. Thorpe, on whose paper to the Institution of Highway Engineers this article is based.

On the Shelf

By Frank H. Smith

I have often felt quite sorry for travelling salesmen although they seem, on the whole, to be a pretty happy and carefree tribe. This was brought home to me quite recently when I decided that some form of quick reproduction process was needed. One sees these ads. for machines that produce copies within a matter of seconds and with the minimum of fuss so that even a moron like me can work them. I rang three different firms, emphasising that all I wanted was literature and no salesmen calling. Is that understood? No salesmen calling. Yes sir, certainly sir.

The very next morning one firm had rung me for an appointment and another had sent along a rep. Result—me hopping mad and venting it on the traveller.

It may be remembered that there was a certain amount of outcry and breast-beating when the DSIR ceased their fuel abstracts in December, 1958. Nothing has appeared to take their place, but in mid-May the Institute of Fuel (18 Devonshire Street, Portland Place, London, W1, LANgham 7124) embark on 12 guineas a year *Fuel Abstracts and Current Titles* (current being as of now and not electric). A booklet and subscription form are available from the address and it is obvious that for just over a quid a month fuellers will welcome this publication. American fuelmanship can benefit at $36. There are other rates for one month and for one-side of the paper versions but it's all laid out in the forms you can get from the Institute.

Ha! The British Standards Institution really are doing something that will affect all of us. They are going to have a technical committee on those handy little things that whip the crown cork off your brown. In putting forward their arguments for such a standardisation they quote cases where people have actually snapped the neck of the bottle. In the same number of *B.S.I. News* (March) is notification of a revised standard for beehives. Who tells the bees? What with that and electronics being applied to the poor little bees they must be getting very self-important little honey-hatchers.

From the Deutscher Normenausschuss (Berlin, W15, Uhlandstrasse 175) comes news of German Standards being translated into English. 820 translations have so far been made and a list is obtainable from that address up there. The list is in UDC order, gives the DIN number, the title in English and the native title. At the back is a numerical index of DIN.

Those preprints from America that I talk about from time to time are invariably so much Baluchistanian to me so it was a pleasant surprise to see Society of Automotive Engineer's Preprint 124B, " Literature Engineering or the Why and How of the Engineer in the Library." Mind you, I don't know what the devil an engineer is doing in a library, but that's beside the point.

School libraries (of the secondary and up types) should send to Shell-Mex and BP Limited, Shell-Mex House, Strand, London, WC2, for their *1959 Book of the Year*. If any boy is still wondering what to do when he leaves, this short coverage of some of Shell's work might help him to decide.

Britannica has a new system by which you can buy the *Encyclopaedia* for the library at about £25 a year. It all reads so detailed and thorough that I will hand it on to you to work out by writing to 11 Belgrave Road, London, SW1.

The Junior Institution of Engineers *Journal* for March carries a paper by Dr. H. L. Haslegrave on " Developments in Engineering Education, Recently and to Come." In the course of the paper he dares to try and forecast 10 points giving the needs of the engineer of 1980-2010. They seem to be much the same requirements as today, particularly No. 10, " to have a very high moral standard." *Only* engineers?

Space Science and Engineering

Guided Missile Engineering. Edited by ALLEN E. PUCKETT and SIMON RAMO. *McGraw-Hill, New York and London.* (77*s* 6*d*)

Fundamentals of Advanced Missiles. By RICHARD B. DOW. *John Wiley, New York; Chapman and Hall, London.* (94*s*)

Proceedings of the VIIIth International Astronautical Congress, Barcelona, 1957. Edited by F. HECHT. Springer-Verlag, Mölkerbastei 5, Vienna 1, Austria. (Members of IAF and subscribers to Astronautica Acta, 170*s*; non-members, 212*s* 6*d*)

Proceedings of the IXth International Astronautical Congress, Amsterdam, 1958. Volumes 1 and 2. Editor-in-chief F. HECHT. Springer-Verlag.

Only a few years ago, the student of rockets and missiles had little to guide him but a number of popularly written books which touched but lightly upon the fundamentals of a vast subject. Two of the first textbooks to appear were Sutton's *Rocket Propulsion Elements* and Bonney's *Principles of Guided Missile Design*, but now important technical contributions are arriving in a steady stream. Two books of special interest are *Guided Missile Engineering* and *Fundamentals of Advanced Missiles*.

The first is intended as an introduction to guided missile technology and is, in fact, published by McGraw-Hill in the University of California Engineering Extension Series. Edited by Allen E. Puckett and Simon Ramo, both well-known figures in the missile world in America, the book combines the work of no less than eighteen practising missile specialists.

The important principles and engineering techniques that go into the making of a modern guided missile are dealt with in turn, including electronics, guidance theory, aerodynamics, airframe performance, radio and radar, computer systems, gyro's, and many other related subjects. A concise survey of the various missile propulsion systems is included, covering both solid and liquid rockets, and ramjets.

Although security considerations still limit what can be said on missile guidance, there is much in this book on the theory of guidance and the principles of missile navigation. However, practical aspects are not neglected. Under the heading, " Random Phenomena," for example, consideration is given to the errors, or " noise," in the guidance system which can influence the efficiency of the weapon's operation. These errors may be due to antenna noise, crystal or detector noise, thermal noise, shot noise in tubes, local oscillator noise, and so on.

Another subject of practical interest is found in the chapter on servomechanisms. There are two basic types: (1) those applied in guidance, navigational, or information systems, and (2) those concerned with speed of response and short-period stability with limited power consumption. In the latter category are mechanisms involved in moving various control surfaces, elevators, rudders, ailerons, jet-vanes, gimballed-rocket engines, and the like, to provide desired moments and lifts.

Fundamentals of Advanced Missiles has something in common with *Guided Missile Engineering*, although in general it is more specialised. The book's aim, we are told, is " to emphasise basic principles in science and engineering that are applicable to, and prerequisite for, estimating the performance of guided missiles, ballistic missiles and space-vehicles." The book treats the operational characteristics of missiles and the function of their component parts under the headings of kinematics of flight; application of fluid mechanics to aerodynamics and propulsion; dynamics; some applications of probability and statistics; properties of microwaves; applications of infra-red radiation; radar; guidance, and missile guidance systems. As in the previous volume, numerous equations are given for each subject.

The author is Richard B. Dow, aeronautical research administrator for the United States Air Force Office of Scientific Research, Air Research and Development Command, who tells us that the book is the result of a number of reflections and conclusions derived from his association with the research and development phases of guided missiles during the past ten years.

His treatment of the various interrelated subjects is logical rather than formal. For example, the principles of propulsion and the properties of propellents are discussed in the chapter on fluid mechanics, for as Dow says, " fundamentally jet flow is as much a manifestation of fluid mechanics as external aerodynamic flow about a body. On the other hand, it is more convenient to associate aerodynamic forces and moments on finite bodies in flight with the dynamic behaviour of these bodies."

Both these books can be thoroughly recommended for the attention they give to fundamental problems over the whole spectrum of missile design and operation, and no technical library priding itself in missile literature should be without them.

The third book is in a quite different category because it deals almost exclusively with ideas and techniques, mostly of a forward-looking character, in the sister-science of astronautics. Its contents, in fact, comprise the collected papers of the 8th International Astronautical Congress, held in Barcelona in 1957. Most of the contributions are of a high technical standard, their authors being among the world's leading authorities. Altogether 46 papers are assembled (including five Russian), and though some are reproduced in the native language of the author, the majority are in English.

In any congress of the International Astronautical Federation, it is unusual if there are not several papers which point the way ahead for subsequent development. Indeed, since 1950, when the first IAF congress was held in Paris, there have been a number of papers which have laid the groundwork for active projects in the field of astronautics. In 1951, for example, when the congress was held in London, three members of the British Interplanetary Society presented the paper, " Minimum Satellite Vehicles," which predated work on Vanguard and Explorer. Two years later, Dr. S. F. Singer brought out his concept for a spherical, instrumented, satellite energised by solar batteries.

At Barcelona, a foretaste of things to come in the realm of orbital relay stations was a paper by R. P. Haviland, of the Missile and Ordnance Systems Department, General Electric Company, which reviewed the use of orbital vehicles as platforms for communication services. The original suggestion that satellites might be used as relay stations for world-wide television had been made by A. C. Clarke, a former chairman of the BIS, as long ago as 1945 in the magazine, *Wireless World*.

In his congress paper, Haviland set out to examine the questions of bandwidth, frequency, antenna pattern, and the possible arrangement and grouping of ground transmitters and space-borne relay stations for a similar global network. Consideration was also given to " passive " relay systems employing 2,000 ft diameter inflatable satellites to act as reflectors in conjunction with large ground antennae.

Last year the Americans announced their intention of establishing " active " communication satellites by 1962 in the so-called 24-hour orbit 22,300 miles from Earth. They also have plans for orbiting 100 ft diameter inflatable satellites for communications experiments this year, using the newly developed Delta rocket.

Space probes are the subject of several papers in the collected volume. One by the Russian V. A. Yegorov outlines various moon-flight trajectories (more than 1,000, he said at the congress, had been computed during studies in Moscow), particular emphasis being given to a close flight around the moon with a subsequent

slightly oblique return into the earth's atmosphere. Mid-course correction by rocket thrust is deemed necessary to obtain this flight path.

Krafft Ehricke of Convair-Astronautics considers "instrumented comets," probe-vehicles that would be sent out into interplanetary space to explore the sun and the solar system at large. Calculations for this paper were run on the IBM 704 digital computer and the results comprise a comprehensive primer for the future design of space-probes and the calculation of their trajectories. One of Ehricke's hopes is that the success of the recent International Geophysical Year will lead to what he terms an International Astronautical Decade, and in his paper he stresses the technical, scientific, political and cultural significance of interplanetary research.

The increasing number of papers presented at the annual congresses of the IAF has resulted, in the case of the 1958 Amsterdam meeting, in splitting the proceedings into two volumes.

Here again, the vast range of subjects involved in the overall field of astronautics proves too much for a detailed review and one can merely point to a few examples among 74 papers. In the contents list included in the first volume, the papers are classified into seven sections: general astronautics; upper atmosphere research; physics of spaceflight; astronautical engineering; propulsion; artificial satellites; and space biology and medicine. In the books, however, there has been no attempt to group the contributions under these headings, which is unfortunate.

The contributions to the 1958 congress range, as before, from the theoretical to the practical, and again there are many examples of original research in a variety of fields. One example is "The Recombination of Atoms, and Other Energy-Exchange Reactions," in which O. K. Rice of the University of North Carolina examines reactions which occur in the upper atmosphere, in shock waves, and in the combustion of fuels. In the engineering category is "General Guidance and Control Concepts for Satellites and Space-Vehicles," by Robert E. Roberson, of North American Aviation Autonetics Division, who considers the problems of guidance and control of various astronautical missions, emphasising the importance of accuracy, reliability, weight economy, and exact foreknowledge of the operating environment. In a second paper, the same author discusses the control of the attitude of space vehicles by means of inertial reaction torque from internal rotating wheels.

In the sphere of space probes, R. P. Haviland of General Electric Missile and Ordnance Department, outlines a scheme for a solar probe to investigate the solar atmosphere, in which he deals in turn with propulsion, thermal design, component temperature limits, attitude stabilisation, and telemetry. Haviland concludes that the present state of rocket engineering limits the distance of the closest approach to the sun to the orbit of Mercury, but that available probe components would permit the design of a probe capable of reaching within 5 million miles of the solar surface.

An excellent paper outlining "Advanced Propulsion Systems for Space Vehicles," is contributed by Ernst Stuhlinger of the Army Ballistic Missile Agency, Huntsville, who compares on a performance basis the relative merits of chemical, solar-heated, nuclear-heated, arc-heated, plasma-jet, and electrostatic ion propulsion systems.

In the second volume, we find a similar diversity of subjects. For example, H. J. von Beckh of the Aeromedical Field Laboratory, Space Biology Branch, describes in detail a series of experiments with jet aircraft in which he personally participated. By means of tight diving spirals and pull-outs, subjects were exposed to positive accelerations of up to $6{\cdot}5g$ for periods as long as one minute, this being either preceded or followed by subgravity trajectories. It was shown that these alterations of acceleration and the weightless state, which are very relevant to spaceflight conditions, actually decreased the subject's tolerance to acceleration and the efficiency of the physiological recovery mechanisms.

An important paper from the British side is one by R. H. Merson of the Royal Aircraft Establishment Guided Weapons Department, which describes the contributions of the RAE satellite prediction service and in particular the radio interferometer and kinetheodolite observations of satellite orbits made by the staff of the Establishment. A table of orbital elements of Sputnik II includes more precise data than the Russians themselves had obtained, or at least, published, at the time of the congress.

One of the "big" events of the Amsterdam Congress was the appearance of Dr. Wernher von Braun, who spoke on "The Explorers," filling in the background to the development of America's first successful satellite launching vehicle, for which he was largely responsible. His paper is reproduced in full in the second volume.

In this volume, too, is the Russian paper "Exploration of the Upper Atmosphere by the Help of the Third Soviet Sputnik," which describes the instrumentation and experiments performed in the 26 cwt "orbiting laboratory."

One can only regret that in the short space available, one cannot do justice to all the excellent contributions contained in the congress proceedings. Not only do these books serve as the best possible reference to the swiftly growing science of astronautics, but in their pages, technical people with an imaginative turn of mind will find a wealth of enjoyment.

KENNETH W. GATLAND

Following the Track of Particles

Meson Physics. By ROBERT E. MARSHAK. *Dover Publications, New York; Constable, London.* (16*s*)

Prior to 1932, nuclear physics had in one sense been simple, in that it was considered that matter was composed of fundamental units of two sorts only, electrons and protons, with equal and opposite charges but masses in the ratio $\sim 1 : 1800$. In 1932, however, the rot set in, and two more fundamental particles were found; positrons, which were identical with electrons apart from having a positive instead of a negative charge, and neutrons which were of very nearly the same mass as protons but were uncharged.

In 1937, charged particles of approximately 200m were discovered (m is the electron mass), later to be named μ mesons. After the war a whole flood of new "fundamental" particles was identified, beginning in 1947-48 with three kinds of π mesons, both charged and neutral, and of mass approximately 270m and continuing in the 1950's with four types of K mesons of mass $\sim$ 1,000m, and many different hyperons, which are heavier than protons or neutrons. One should also include in the post-war flood of discovery the neutrino, a particle of zero mass and charge, whose only "property" is its intrinsic angular momentum, and whose existence was postulated before the war but which was only experimentally identified in 1956.

All of these particles apart from the neutrino, electron and proton are unstable with lifetimes varying from approximately 10 minutes in the case of the neutron to 10^{-16} sec in the case of the neutron π meson. The decay products are either gamma rays, leptons (electrons, positrons or neutrinos) mesons (μ, π or K) nucleons (neutrons or protons) or lighter hyperons, but the majority of the decay processes involve the production of a π meson. The π meson thus occupies a most important, not to say dominating, position in the hierarchy of fundamental particles. Among other things, it is the particle responsible for the attractive forces between nucleons which keep atomic nuclei together.

The present book, which was written by one of the most vigorous contributors to meson theory, is largely devoted to π mesons, their modes of production, their interaction with nuclei, and their decay. It is, unfortunately, completely out of date.

One should hasten to add that this is no reflection on the author. The book is an unaltered reproduction of the first edition, which appeared in 1952. When this book was written, it was almost the only book on the subject, and was remarkably up to date. It presents a first-class account of both the theoretical and experimental situations as they existed at approximately the end of 1951, and contains copious references to the original work. It is addressed primarily to research workers in meson physics and assumes a good background knowledge of quantum mechanics.

However, if one considers the branches of π meson physics which are of current interest, as evinced by the review papers at the big international conferences on fundamental particle physics which have been held in recent years, one finds that the book under review has very little or nothing to say on them. In fact, the subject in 1952 was just beginning to emerge from the "botanising" stage, and its state of evolution at that time did not allow a clear picture of the π meson and its various interactions to be drawn.

This is largely because the advance of knowledge of a new subject is so closely linked to experimental progress. In a new field, while experimental techniques are being developed, one makes what measurements one can, and frequently finds that what is experimentally the simplest quantity to measure is theoretically the most complicated to interpret. For example, only after a great deal of experimental experience had been gained was it found possible to make measurements on the scattering of π mesons by protons, which is one of the simplest problems to formulate theoretically.

The meson-proton interaction is perhaps the most important "property" of the π meson, and nearly all the work on this branch of the subject on which our present understanding depends has been carried out since this book was written.

Reluctantly, therefore, one is unable generally to recommend this book in 1960, though it contains many details, for example, a careful treatment of certain kinematical relationships, for which at least one experimentalist is grateful. It has been rendered obsolete by the progress to which it has surely contributed.

B. ROSE

Lectures on Nuclear Theory. By L. D. LANDAU and YA. SMORODINSKY. Translated from Russian. *Plenum Press, New York; Chapman and Hall, London.* (45*s*)

The engineers' usual contact with the subject of this book is in the design and construction of the research tools of the high-energy laboratory—high voltage generators, cyclotrons, linear accelerators and proton synchrotrons. The authors are not however concerned with the experimental side of the subject but concentrate on the fundamental physics of the nucleus. The book is based on a series of lectures delivered to experimental physicists by one of the authors (L. Landau) in 1954. There are ten lectures in all and the main topics discussed are nuclear forces nuclear structure, nuclear reactions and π meson physics.

For nuclear physicists to whom this book is addressed these lectures provide an excellent

Continued on next page

introduction to nuclear theory. Although the mathematical content is kept to a minimum, nevertheless some understanding of the basic concept of quantum mechanics is demanded for more than a superficial appreciation of the lectures. Quantum mechanics is the mathematical equipment of the nuclear theorist; his problem is to use this to produce a complete theory which will explain the forces which act between nuclear particles.

The first few lectures are devoted to a discussion of the forces acting between proton and neutron—the elementary particles of the nucleus. Apart from the Coulomb force due to electric charge there is also a short-range nuclear force which is responsible for binding several neutrons and protons together to form nuclei, of say, oxygen or uranium. During the past decade the nature of this force has been investigated by bombarding target protons with either protons or neutrons over a wide range of energies. Although much has been learned from this, nuclear theorists have yet to produce a complete theory of nuclear forces. Part of the complication is caused by the fact that in addition to the radial force acting between pairs of nucleons the spin of the particles must also be taken into consideration. In addition there is another effect, with no classical counterpart, which is the possibility of a neutron and proton exchanging charge during the scattering interaction. Recent work in this field has involved the use of polarised beams of protons and neutron. It should be noted in this respect that Landau gave his lectures in 1954 and some of the more recent work is not reported. Scattering experiments, for example, have now been extended to energies above 10^9 volts with the high-energy synchrotrons.

It is clear that with so much complication in the forces acting between pairs of nucleons no simple model can represent all the properties of an extremely complicated quantum system such as the nucleus. Several lectures are devoted to describing the various attempts that have been made to produce nuclear models—each of limited application. For example, there are theories appropriate to the lighter nuclei—the shell theory or independent particle theory—which is analagous with the electronic shells of atomic theory. At the other end of the scale, there are statistical theories applicable to the heavier nuclei with properties similar to drops of liquid. According to the theory of quantised states nuclei can exist in discrete configurations to which an energy level is attributed. By bombarding nuclei with energetic particles, transformations can be produced from one level to the other. The chapters on nuclear phenomena are concerned mostly with these aspects of the theory, especially in the lower energy range of nuclear excitation.

In the final set of lectures attention is directed to higher energy aspects of the theory. There is first of all a discussion of the phenomenological picture of the nucleus as an optical medium causing both refraction and absorption of the incoming particles. According to quantum mechanics the motion of a nucleon is described by a wave function and the scattering nucleus is represented by a sphere of complex refractive index, to represent both scattering and absorption. The problem is to choose suitable parameters for the nucleus which will fit experimentally observed effects. In recent years refinements have been introduced to take into account charge, spin and distribution of nuclear matter which considerably complicates the simple theory.

Another important feature of high-energy scattering is the production of secondary particles. Only the π meson which requires an incident proton energy above 200 Mev is introduced in these lectures. At even higher energies there are of course a number of new particles which can be produced such as K mesons and the so-called "strange" particles; these have been the main topics of research in recent years with the highest-energy accelerators—the proton synchrotrons. The final two lectures describe in simple terms the production and decay of π mesons and their interaction with nucleons.

Although these lectures are by no means a popular account of nuclear theory they should nevertheless appeal to the non-specialist who wishes to understand the fundamentals of the subject. They are written in a style which is both readable and lucid.

WILLIAM WALKINSHAW

New Books

Britain: an Official Handbook. Prepared by the Central Office of Information. 1960 edition. *Her Majesty's Stationery Office.* (25*s*)

A survey of all the aspects of this country and its life, produced in a well organised and illustrated manner. A useful general bibliography, unusual in including both source and price, appears at the end of the volume.

F.B.I. Register of British Manufacturers, 1960. 32nd edition. *Published for the Federation of British Industries by Kelly's Directories and Iliffe and Sons.* (42*s*)

The products section contains a classified list of products and services of over 7,500 member firms, with French, German and Spanish glossaries appended. In addition there are indexes to company names and addresses, trade names and trade marks.

The Shipping World Year Book and Who's Who, 1960. Edited by Donald Maxwell. *The Shipping World Ltd., 1 Arundel Street, London, WC2.* (60*s*)

Nearly 250 pages of this reference book are taken up with a specialised who's who of the shipping world; the classified directory section covers shipowners, builders, and repairers, marine engine builders, and salvage contractors.

B.B.C. Handbook, 1960. *British Broadcasting Corporation.* (6*s*)

A comprehensive and up-to-date picture of what the BBC does, with details of programmes, external services, and the operations of the engineering department.

Industrial Directory of Wales and Monmouthshire. 4th edition, 1960. *The Industrial Association of Wales and Monmouthshire, Aberdare House, Mount Stuart Square, Cardiff.* (21*s*)

A classified buyers' guide to Welsh products and services, with an annotated alphabetical list of companies. Issued at four-yearly intervals.

European Plastics: European Manufacturers of Raw Materials, Semi-finished Products and Auxiliaries for the Plastics Industry. *Economic Documentation Office, Hilversum, Holland.* (25*s*)

A new directory, covering some 700 manufacturers in 13 European countries. The classification of products is clear, and indexes are provided in English, Italian, German, Spanish and French.

Kempe's Engineers Year-Book for 1960. 65th edition. Edited by C. E. PROCKTER. 2 volumes. *Morgan Brothers.* (87*s* 6*d*)

The latest edition of this indispensable reference book contains much new material in such fields as electronics, nuclear power, prestressed concrete, diesel ocomotion, and railway brakes and signalling.

Répertoire National du Commerce Extérieur, 1960. *Union Francaise d'Annuaires Professionels, 94 rue Lauriston, Paris 16, France.* (5,000 *frs*)

A classified directory of French industry, provided with indexes in French, English, German and Spanish, and with an introductory section on French governmental agencies and their overseas representatives concerned with trade.

The Empire and Commonwealth Year Book, 1959-60. Edited by RONALD S. RUSSELL. *Newman Neame.* (50*s*)

Includes details of location, history, population, and trade, of all 80 countries and territories of the Commonwealth, and surveys of raw materials and commodities over the whole area.

The Directory of Opportunities for School Leavers, 1960. *Cornmarket Press.* (8*s* 6*d*)

Details of openings in 165 industrial and commercial organisations and government departments. Classified index and articles on training facilities.

The Reviewers

Mr. Kenneth W. Gatland is a fellow of the British Interplanetary Society (vice-chairman since 1957) and a fellow of the Royal Astronomical Society. He was formerly with Hawker Aircraft Limited, where he was a member of the design staff for 18 years. He is the author of *The Inhabited Universe, Space Travel* and *Development of the Guided Missile*, together with various technical papers relating to astronautics. He is editor of *Spaceflight*, published by the BIS, and is now contributing editor to *The Aeroplane and Astronautics*.

Mr. Basil Rose is a member of the cyclotron group at the Atomic Energy Research Establishment, Harwell.

Mr. W. Walkinshaw, M.A., is deputy chief scientist in the theoretical physics division at the Atomic Energy Research Establishment, Harwell.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Plastics. POLYPENCO LTD., Tewin Road, Welwyn Garden City, Herts. Leaflet contains brief details of properties of eight plastics made by the company. Includes chlorinated polyether and polycarbonate (two new plastics).

Detergents. CYCLO CHEMICALS LTD., 376 Strand, London, WC2. How to make your own detergents at lower cost, based on one of the firm's products. Six pages.

Rare Earth Metals. JOHNSON MATTHEY & CO. LTD., Hatton Garden, London, EC1. If praseodymium means anything to you, write for this booklet.

Asbestos and Asbestos-Cement. TURNERS ASBESTOS CEMENT CO. LTD., Trafford Park, Manchester 17. Twenty-eight page booklet on asbestos as a raw material and extensive range of asbestos-cement products.

Building Fillers. EXPANDITE LTD., Chase Road, London, NW10. Short guide to the whole range of the firm's building products.

Aluminium Thermal Insulation. NORTHERN ALUMINIUM CO. LTD., Banbury, Oxon. Small guide to important uses of aluminium in insulating buildings.

Thermometals. HENRY WIGGIN & CO. LTD., Wiggin Street, Birmingham 16. Basic information on "Wilco-Wiggin" thermometals—for bimetallic strips. Useful for designing.

Coatings for Exhaust Valves. HENRY WIGGIN & CO. LTD., Wiggin Street, Birmingham 16. Booklet on use of "Brightray" coatings for exhaust valves. Methods for reclaiming.

Refactories. STOURBRIDGE REFRACTORIES CO. LTD., Brierley Hill, Staffs. Brochure of products. Especially firebricks and refractory cements.

Molybdenised Lubricants. K. S. PAUL (MOLYBDENUM DISULPHIDE) LTD., Angel Road, London, N18. Distilled experiences with molybdenum disulphide. Illustrated, indexed.

Extruded Aluminium Products. NORTHERN ALUMINIUM CO. LTD., Banbury, Oxon. Manufacturing limits and manufacturing tolerances on Noral extruded products. 20 pages; part 1 of a series.

Chemical Makers. ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS, 86 Strand, London, WC2. 1959 edition of previous publication which is a guide to makers of 12,000 chemical products in Britain.

Welding Nimonics. HENRY WIGGIN & CO. LTD., Wiggin Street, Birmingham 16. Latest technical data and operating instructions for oxy-acetylene, argon-arc, and other welding processes for use of alloys in gas turbine assemblies.

Aluminium Extruded and Drawn Products. IMPERIAL CHEMICAL INDUSTRIES LTD., Millbank, London, SW1. What does the new firm Impalco make? Here is part of the answer. Ten pages, mainly illustrations.

Jointing Strip. THOS. W. WARD LTD., Albion Works, Sheffield. Compri-Strip of foamed plastics impregnated with bitumen; for expansion joints in concrete, windows, etc. Folder.

Marketing

Spanner in the Post

A 14 ounce adjustable steel spanner arriving through the letterbox at breakfast time would stand a reasonable chance of being noticed.

Almost equally sure of attracting attention is PRESTIGE ADVERTISING'S device of issuing circulars with a full size cardboard replica of the quickly adjusted SLIK spanner, detachable from the literature and printed with what looks very much like a chrome finish.

The circular is accompanied by a pre-paid envelope, and by a confident request to send a postal order and name and address in order to keep down overheads and allow the spanner to be sold post-free.

Sheet Steel Annealing Order for Newport

RICHARD THOMAS AND BALDWINS have placed an order worth more than £1¼ million for steel sheet annealing plant with an output of 16,500 tons a week for their new Spencer steelworks at Llanwern, near Newport, Monmouthshire.

Thirty furnaces of single and four stack design, furnace bases, forced cooling hoods and other equipment will be supplied by the INCANDESCENT HEAT Company Limited, of Smethwick. The furnaces will be the Incandescent radiant bowl type, already in use in British and overseas steelworks.

The coil annealing plants output will be almost 100 tons an hour of 60 in wide strip. Llanwern is scheduled to begin operating in October next year.

No Helicopters on Brighton Beach

By the narrow majority of 34 votes to 32, Brighton Town Council have turned down the proposal for a helicopter port on the town's beach.

The interests of the local hotel and boarding house proprietors have thus been safeguarded in the matter of noise but the council members do not propose to let it rest at that. Mindful, perhaps, of the prosperity the railway and now the car has brought to their "London extension" they do not propose to be left behind in a possible helicopter-age.

The planning committee has been instructed to find another, presumably less sensitive, spot.

First Foreign Plastics Exhibition in Russia

Many of the latest techical developments in the IMPERIAL CHEMICAL INDUSTRIES' Plastics Division will be shown to Russian scientists and engineers this summer when ICI set up their plastics exhibition in Moscow and Leningrad.

The Plastics Division, the largest plastics materials manufacturer in the United Kingdom, will provide chemists and technologists who will lecture and establish informal contacts.

R. H. WINDSOR Limited, the machinery manufacturers, of Chessington, Surrey, will be going along too. One of their extruders will be used in demonstration of recent developments in technique and members of the firm's staff will be showing injection moulding and extrusion.

The static displays for the exhibition have been designed by Mario Armengol, the Spanish designer.

Oil in Dorset and the Sahara

No estimate is yet available from the BRITISH PETROLEUM EXPLORATION COMPANY Limited as to whether there is enough oil under Dorset, where test drilling is going on at Kimmeridge, for extraction to be worthwhile. What there is has a high quality. Of two wells that were begun on the cliffs, one has been temporarily stopped at a depth of 1,816 ft and another is still going strong—3,381 ft down and probably going on down to 5,000 ft.

It is one of the trials of the drilling crews that they have to take hours of time off while the Army practises firing conventional weapons.

Less good natured are some of the exchanges over French oil from the Sahara. While the Government proclaims probable annual output of 40 to 50 million tons by 1965, the French ESSO STANDARD publication *Newsletter* is now giving 25 to 30 million tons as more likely. Since the refinery capacity of the franc zone is currently 30 million tons the difference is between a manageable and an unwieldy surplus.

Highly unpopular with the distributing companies is the French Government proposal to organise the small French distributors into one national company refining and marketing Saharan oil. Such a set up would be in direct competition with the crude oil supplies from the Middle East, already distributed by Cie. Française des Pétroles.

The sharper tone that is being taken on in the relationship between the international oil groups and the French Government is not the happiest way for the French to approach the situation where, according to their own official estimates, there should be a surplus of Saharan oil which the "internationals" might be expected to be best placed to distribute.

Westinghouse to Supply Drives for Russian Mill

The 50,000 spindle textile mill being built by United States firms for Russia is to have all its electrical drives supplied by the WESTINGHOUSE ELECTRIC INTERNATIONAL Company. The contract is worth about £350,000.

In addition to 1,500 motors, from one to 20 horsepower, Westinghouse will be providing the controls and PRECIPITRON electronic air cleaners. Lint-free textile motors have been specified.

The mill is to be at Kalinin, 100 miles from Moscow. The main contractor for the $20 million operation is INTERTEX INTERNATIONAL INCORPORATED of New York. More than 40 US companies are concerned in the mill and its equipment.

An earlier Westinghouse contract for Russian textile mill equipment was also through Intertex, for $125,000 worth of electrical equipment for a 15,000 spindle worsted and synthetic yarn mill and a tufted carpet mill.

Tariff Cuts Give Impetus to St. Erik

The first tariff cuts of the British led European Free Trade Area (popularly the Outer Seven) take effect from 1 July this year. Two months later the St. Eriks Fair starts in Stockholm. The advantage to British exporters is obvious.

Even more than in the United Kingdom, Sweden's standards of home consumption are met by imports. In Britain 18 per cent of the goods bought come from abroad, in Sweden it is rather over a quarter. But only 14 per cent of Swedish imports are from this country while 23 per cent are from Western Germany. The opportunity provided by the progressive tariff cuts of the EFTA to reverse this situation is all the stronger, in that Britain buys far more from Sweden than does Germany.

Last year the St. Eriks Fair was attended by 304,000 visitors, 105,900 of them trade buyers, 34,000 of them in the general section and 71,900 in the special section.

This year, when the fair will continue from 31 August to 11 September the special section will include industrial equipment and instruments, electrical motors and equipment, plastics, rubber and leather goods, sports equipment, scientific instruments, restaurant installations and agricultural, mining and forestry equipment.

The general section, in addition to exhibits in the special division, will show household and kitchen appliances, furniture, textiles and textile equipment and radio and television sets.

The special section is open to buyers only and the general to buyers in the morning and then to all-comers in the afternoon and at week-ends. TRADE FAIRS AND PROMOTIONS Limited are handling British participation.

Western Germany and the Netherlands are to build pavilions. Space has been booked by Poland, East Germany, Portugal and Hong Kong, and enquiries have been made by Italy, Austria, Switzerland, Japan, and the Argentine.

British Motors Return to the Argentine

In conjunction with the largest engineering company in South America, SIAM DI TELLA, Buenos Aires, the BRITISH MOTOR CORPORATION are returning to their once valuable market in the Argentine.

A first shipment of 500 cases of BMC car components has sailed on the SS Swan River for Buenos Aires. The components will be assembled into 700 cars and marketed under the name Di Tella. The new car has body pressings common to the Farina Riley and uses a BMC 1,500 c.c. engine.

BMC engineers have been in the Argentine since the signing of the agreement with SIAM last year, working on the equipment of a new assembly plant. Over the years an increasing proportion of each car will be made on the spot. At the moment Argentinian manufacture is limited to the tyres, glass, batteries, paint and trim.

The parts for more than 7,000 cars are to be sent out this year. The aim is to recover the position that existed before the door was closed in 1948 and to build up sales to a yearly figure of several million pounds.

Between 1946 and 1948 more than 7,500 Austin and Morris cars and commercial vehicles were sold in the Argentine. They were 67 per cent of the whole export of the British motor industry to the country in those years.

One of the existing and diverse activities of SIAM is the production of LAMBRETTA scooters.

Lignite in Australia's Latrobe Valley

A ten-fold increase in Australia's power demands over the next 40 years is forecast by the Director of Engineering for the VICTORIA STATE ELECTRICITY COMMISSION, Dr. N. T. Jewell.

Speaking to a convention of the Institution of Engineers of Australia, Dr. Jewell said that most of these power needs must be met from the important brown coal deposits in the Latrobe Valley.

Another speaker described the valley as the greatest source of fuel and power in the Southern hemisphere. Known deposits have been put as high as 6,000 million tons and last year's output was 11 million tons. Dr. Jewell expects the present Australian power consumption of 1,280 MW to rise to 14,800 MW by the year 2000.

Increasing the BBC's Income

The gradual rise in the proportion of revenue the BBC receives from sound radio and television licences, from the present 92½ per cent net to 100 per cent net in 1962-62 means that the Corporation will have a little elbow room for the developments in sound and television it has planned.

There are still 750,000 people beyond the range of the BBC's television transmitters. In addition to ending this state of affairs it is also intended to devote further effort to improving service in areas where reception is not all that it might be.

Fourteen satellite television stations and 10 low-power vhf satellite stations are being built.

Set-Back for Decca

The 12-man air navigation commission of the INTERNATIONAL CIVIL AVIATION ORGANISATION has voted in Montreal in favour of the United States Vor-dme navigational system as a standard equipment for the greater part of the world air routes.

The decision of the navigation commission is being sent to the ICAO council for a final ruling. Since the agreement of two-thirds of the 21 strong council is needed to achieve a standard ruling a fiercer fight than went on in the commission's meeting is probable.

The British—Decca—system was turned down at a plenary session of the ICAO last year when the voting was unanimously for the American equipment.

The voting in the commission's recent meeting, in Montreal, was Britain, Norway and Canada against, the United States and six others in favour of the United States Vor-dme, and two abstentions.

Longer Fatigue Life for Nuts and Bolts

Fatigue tests in tension at the Royal Aircraft Establishment, Farnborough, provide preliminary data for the development of bolts and nuts for use where fatigue failure is likely.

Over a period of years, Dr. R. B. Heywood, M.I.Mech.E., has made fatigue tests on a number of unconventional bolt and nut systems. In a Royal Aircraft Establishment (Farnborough) paper "The Effect of Some Design Features on the Fatigue Life of Bolts and Nuts," he gives the results of his findings for bolts of special design. Some of these depart radically from the conventional and include, for example, threads with a 90° included angle and nuts with conical-faces.

The bolts, all nominally of $\frac{3}{4}$ in diameter, were in 60 ton steel and the nuts in 40 ton steel. All the fatigue tests were carried out in axial tension at a load of $5{\cdot}2 \pm 2{\cdot}38$ tons and the results compared on a life basis. Failure of the bolts and nuts occurred in widely different positions, depending on the characteristics of the individual design, as may be seen Fig. 7.

The detail design of four regions of the bolts and nuts, the threads, the bolt head, the bolt shank and the nut, were considered.

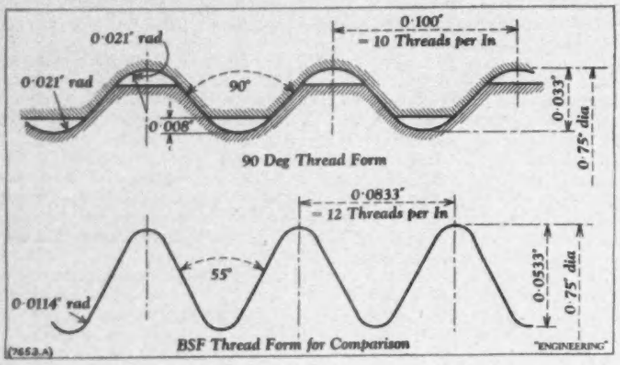


Fig. 1 The 90° thread form has a longer fatigue life than the standard BSF form.

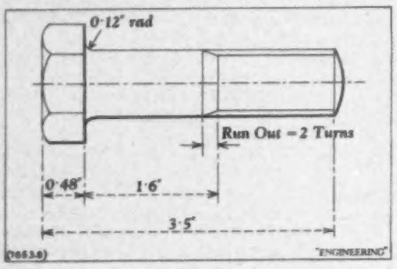


Fig. 2 The standard 0·12 in radius under the head is sufficient to avoid fatigue failure.

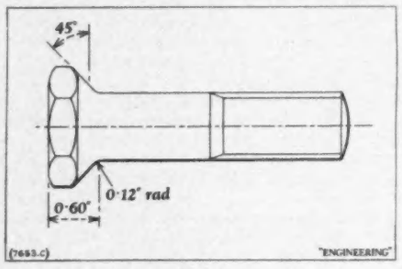


Fig. 3 A 45° conical head also has good fatigue characteristics.

Thread Form

All the standard BSF bolts had typical failures with the cracks initiating near the contact face of the nut. No failures occurred at the thread run out on the shank when standard nuts were used, but with nuts of improved design some failures in this position took place at considerably higher lives. For the 90° thread form, two series of tests confirmed earlier thoughts that a 90° thread (Fig. 1) should increase the fatigue strength considerably. The value of the 90° thread form has, in fact, been confirmed by A. V. Roe on structure tests with these bolts. Increased lives were also obtained with BSF threads by having a slightly longer pitch for the nut threads or by tapering the line of threads. Both these measures improve the thread load distribution.

Bolt Head Design

The head fillet radius is not normally critical. A standard radius of 0·12 in (Fig. 2) connecting the bolt head to the shank is sufficient to avoid failure in the fillet under axial loads. Tests using a 45° conical head on the bolts (Fig. 3) did not result in failure under the head and so this design is satisfactory under fatigue. A bolt head

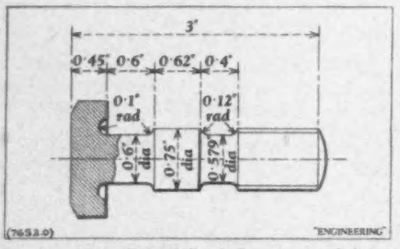


Fig. 4 An undercut fillet below the head did not produce fatigue failures.

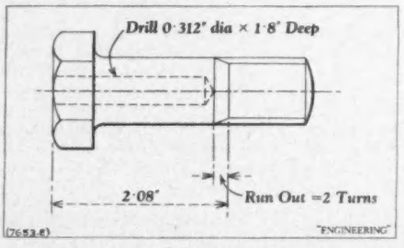


Fig. 5 An axial hole of limited diameter in the bolt improves fatigue strength of the shank.

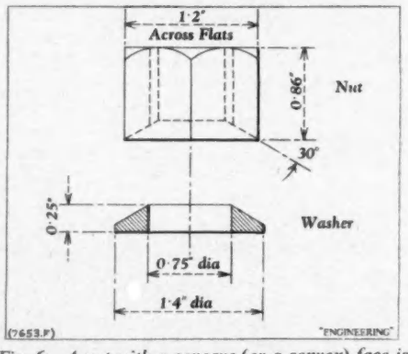
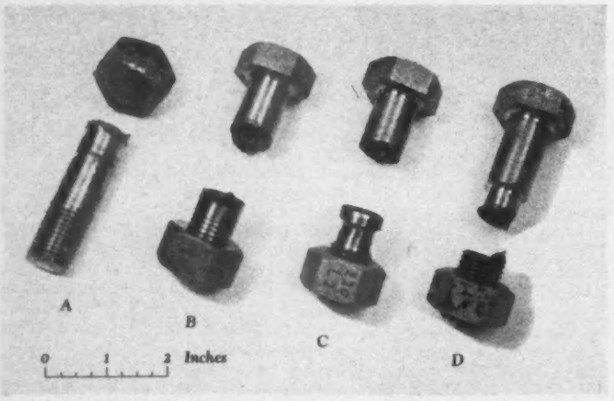


Fig. 6 A nut with a concave (or a convex) face is generally superior to the standard nut.



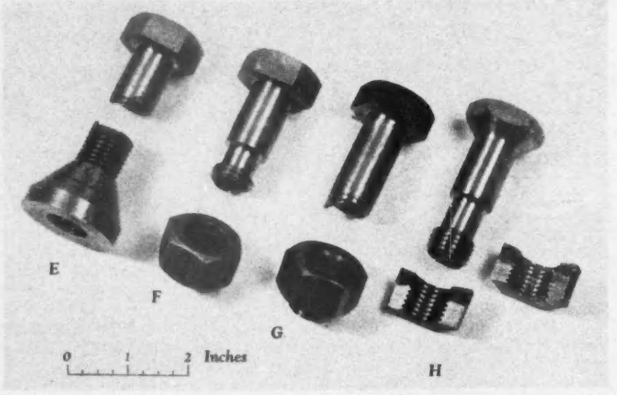


Fig. 7 shows fatigue failures at various positions along the bolt and nut assembly and is remarkable for the different positions of failure. (A) Head fillet, (B) Shank on full diameter (C) Shank at end of axial hole (D) and (E) Start of thread (F) Thread, in line with nut face (G) Thread below nut face and (H) Primary failure of the nut.

with an undercut fillet (Fig. 4) has the advantage of producing 75 per cent greater flexibility of the head. In the tests made, failure of the head did not occur, and so the design is promising.

Bolt Shank Design

Failures of the full shank in fatigue do not normally occur. In manufacturing bolts, it is sometimes convenient to terminate threads at a groove in the shank. The effect of this circumferential groove on fatigue strength was tested for various positions of the nut with respect to the groove, but it does not seem to have any effect. The use of an axial hole drilled from the bolt head is desirable in that it reduces both the weight and the stiffness of the bolt. Three diameters of axial hole were investigated, viz., 0·312, 0·406 and 0·469 in, and Fig. 5 shows the bolt for the second case. The first two were satisfactory from a fatigue point of view but the third, which also incorporated a circumferential groove in the shank, failed at a comparatively short life and was therefore unsatisfactory.

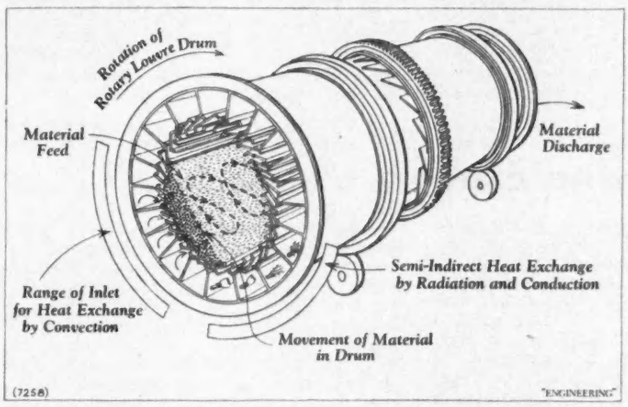
Design of Nut

The distribution of load between the mating threads of the bolt and nut is influenced in large measure by the design of the nut. While considerable scope for design is offered in this direction, only one parameter was investigated in these tests, namely, that of the direction of the load applied to the nut face. This was varied by providing a convex or concave face to the nut and using, if necessary, a suitably shaped washer. In general, these designs are superior to the standard design of nut, although some cause a considerable increase in weight. The 30° concave nut of Fig. 6 was promising as only one of the four failures occurred in the bolt thread in the region of the nut. Satisfactory lives were obtained with this type of nut in tests with 90° threaded bolts.

Drying Fine Materials without Waste

Dunford & Elliott Process Engineering Limited, of London, SW8, manufacturers of rotary louvre drying and cooling equipment, have developed an efficient method of processing very fine materials with this equipment. The rotary louvre principle, up to now, has not been fully satisfactory for treating this type of material, because the speed of the heating or cooling air had to be limited in accordance with the fineness of the material being processed.

Briefly, the rotary louvre drying and cooling equipment consists of a rotating horizontal drum with a series of internal radial plates on which lies the material being processed. A current of warm or cold air, admitted through a series of tangential louvres, passes through the bed of material while this is slowly turning over and is travelling to the discharge outlet. The new system of operation prevents the carrying away of fine materials, by eliminating the current of air and effecting the heat transfer by heating or cooling sections of the internal louvres before they enter the bed of the material. When heating, a flame (or alternatively hot air) is applied directly to a number of louvres which in turn rapidly transfer their heat to the material. When cooling, sections of the louvres cooled by air successively extract the heat.



The rotary louvre drying and cooling drum made by Dunford and Elliott. The tangential baffles are designed to prevent the incoming air current carrying away the fines in the material being processed.

This system of heat exchange by conduction (for which a patent has been applied) can be supplemented by a small volume of hot or cold air passing through the material bed at a velocity which suits the fineness of the material being processed. Since the material does not at any stage drop through the air current, a negligible amount of fines is carried away.

The method has been used with great success for a number of applications; two typical ones being the drying of black iron oxide filter cake, in which the moisture content was reduced from 25 to 0·1 per cent, and the processing of a catalyst based on diatomaceous earth in very fine powder form. In the latter case, the moisture content was reduced from 6·6 per cent to zero, the maximum temperature the material reached during processing being 400° C.

This semi-indirect system can also be applied during normal rotary louvre operation to the processing of materials in the form of large crystals, in order to obtain an additional heating or cooling effect by pre-heating or pre-cooling the louvres before they enter the bed of the material. In a comparison made between this method and the conventional rotary louvre system of operation during the cooling of sugar from a temperature of 44° C, a discharge temperature of 20° C, with an increased throughput of sugar, was obtained with the new system, as against 27° C with the conventional method. This is an increase in cooling efficiency of over 41 per cent.

For processes requiring high temperatures, such as 350 to 500° C at discharge, the louvres are manufactured from heat resisting steel and the design of the equipment allows for the differential expansions experienced in such cases.

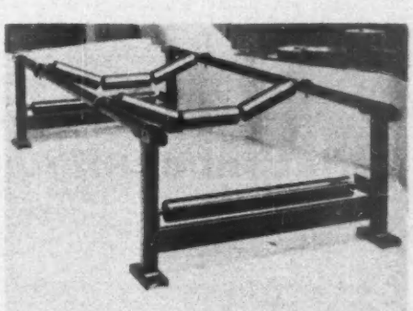
Sprung Troughing for Conveyor Belts

The troughing angle of a belt conveyor idler must be shallow enough for the empty belt to bed down into contact with the centre roll for effective training. On the other hand, for maximum carrying capacity without spillage, the troughing angle must be as deep as possible. These two opposed requirements result in the compromise angle of the conventional troughed idler now in general use.

With the Meco suspended idler structure, made by the (Mining Engineering Company Limited, Worcester, the idlers trough under load and so both requirements are fully met.

The deep troughing of the carrying belt under load makes possible the general use of a simple open structure, but cover plates for the bottom belt can be fitted if desired near loading points. The structure may be floor-mounted or slung. Structure stools are fabricated from rectangular tubes to give lightness, strength and rigidity. The 4 in diameter return roller carries the belt 12 in above floor level and is positioned above the cross member so that the return belt can be run out over the rollers without threading. The roller is adjustable for belt training purposes and the clearance through the stool is belt width plus 8 in. The stool cross member is well above floor level to give ample clearance for cleaning out. The stringers are tubular and are secured in the open channel tops of the stool side members by simple knock-in pins. Steel pressings clip over the stringers and are located by countersunk spigots entering holes drilled in the tubular stringers. They receive and position the suspended idlers.

The troughed idlers consist of three rolls flexibly coupled together by flat chain links. The rolls are of standard Meco design, employing accurately machined iron castings housing high grade ball bearings mounted on ground steel spindles. The bearings are grease packed and protected by efficient sealing units and the whole design is such that servicing can be carried out simply and quickly without special equipment. Housed entirely within the side rolls are heavy spring assemblies coupled to hooked bars upon which the idlers are resiliently suspended, the sliding coupling being protected by a hollow seal. The hooked bars clip over the tubular stringers of the structure and the idlers trough against the spring loading in relation to the weight of material on the belt, up to the limit imposed by the restriction of the spring yield. For an empty belt, the idler troughing angle is approximately 20°, and this allows even the stiffest belting to make full contact with the middle roll for effective belt training. The troughing angle then increases progressively with load up to a limit of about 35° with a fully loaded belt. The freely suspended, flexibly linked idler takes the form of the loaded belt, yet remains resilient to avoid any possible damage from bulky material.



The idlers in the Meco system are sprung so that the belt troughs under the load it is carrying.

In practice, assembly of the structure is simple and quick. Stools with bottom rollers in place are spaced out, tubular stringers dropped into the stools and secured, and the troughed idlers clipped over the tubular stringers.

Overdrive Unit for Vauxhall Cresta and Velox

An overdrive unit is now available for the Vauxhall Cresta and Velox. It can be ordered as a factory-installed option, giving an overdrive second gear of 1·272 : 1 and an overdrive top of 0·778 : 1. Normal bottom, second and top gear (2·866 : 1, 1·635 : 1, and 1 : 1) operate when the overdrive unit is switched out. The fitting of the overdrive to existing cars is not straightforward. Some modification of the standard gearbox is needed, as well as a new propeller shaft and universal joint assembly.

The overdrive unit is of the Laycock de Normanville type, using a sun and planet gear train. It fits behind the gearbox and is controlled by an electric switch. In direct drive (Fig. 1) the engine power passes to the propeller shaft through a unidirectional roller clutch, the gear train being inoperative. A sliding, splined cone-clutch holds the sunwheel and annulus together by means of spring pressure, locking the gear train solid. By this means engine braking is available. The cone clutch also drives the car in reverse.

In overdrive, hydraulic pressure opposes the spring pressure on the splined cone clutch, causing it to engage with the conical brake ring built into the main casing. As the sun wheel and the cone clutch are integral, the former is now held stationary and the annulus driven through the planet wheels to a higher speed than the gearbox shaft. Hydraulic pressure is derived from a pump and released to the clutch by a solenoid, electrically operated by the switch on the dash.

The overdrive can be engaged or disengaged at will at any speed above, say, 20 m.p.h. in second or 30 m.p.h. in top, depending on circumstances. It should be operated without using the clutch pedal and with the accelerator at least partially depressed. The unit is designed to be operative when transmitting full power.

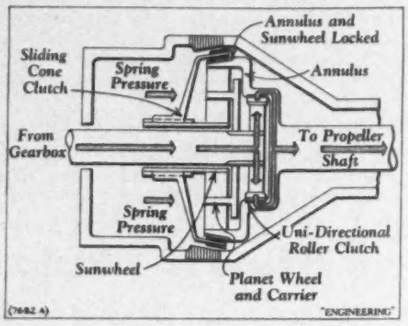


Fig. 1 Schematic of the Laycock de Normanville overdrive unit in direct drive position. The unit is basically a sun and planet gear train.

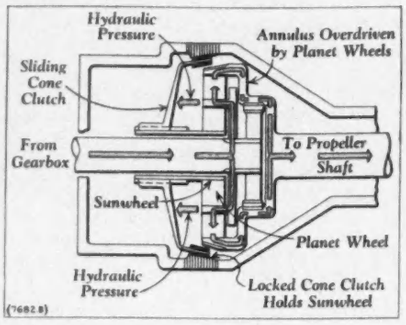


Fig. 2 Schematic of the unit in the overdrive condition. The gear ratio between the input and output is 0·778 : 1.

Reducing Noise in Vehicle Transmission

Transmission noise in a vehicle can often be difficult to trace unless frequency analysis techniques are used. An example is given by some work carried out by A. Y. Turasov, Gorki Autoworks, on a GAZ-63 truck. At 20 and 30 km.p.h., direct drive, heavy noise was noticed apparently from the gearbox or the transmission distribution unit. Oscillograph recordings made at 30 km.p.h. showed the propeller shaft universal joints to be the source of the noise. It was found that torsional resonance vibrations were excited in all gears at this speed by the fluctuating component of the engine torque combined with uneven rotation of the secondary propeller shaft. The latter occurred because of unfavourable angular alignment of the propeller shafts, which coincided at a frequency of 43 c/s. By altering the angle of the transmission distribution unit by 3°, almost complete elimination of the noise was achieved.

To combat the noise and vibration at 20 km.p.h. in direct drive (and 12 km.p.h. in third gear), it was found necessary to fit a clutch-driven plate with springs and a friction damper. This reduced noise by about 5 dB at both speeds. An English summary of Turasov's work is published by MIRA Lindley, Warwickshire.

More Power for BRM's this Year

Broken valve springs put both BRM's out of the Argentine Grand Prix. The cars have been incorrectly reported as having had trouble with loss of oil pressure and overheating; but Owen Racing Motor Association say that, apart from the broken springs, the cars ran well throughout the race, and either could have won but for this fault. The failure is surprising as it was thought this sort of trouble had been overcome—no valve spring failure occurred last year.

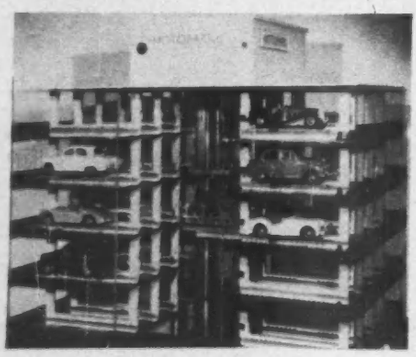
Both BRM's in the race were 1959 rear-engined cars. Much development work has been carried out on them during the winter, the cylinder heads being modified to improve cooling.

In the Formula Libre race at Cordoba, Dan Gurney made his debut for BRM. He had a good lead over the rest of the field, after Jack Brabham retired, until the gear mechanism "became deranged." Forced to drive the car in the gear it was in—top—he came in second. Bannier in the other BRM came in fifth.

It is possible that the front-engined cars may be seen again this season, but the main BRM effort is concentrated on the new rear-engined car that was tested last year at Monza. The layout has been cleaned up and embodies a new, rather longer chassis frame with straight parallel tubes running the full length of the car. The engine used is still the 1959 four-bearing unit, but it now gives a great deal more power. Development work is in progress on fuel injection and also on a five-speed gearbox. But these will not be ready until later on in the season.

OMRA hope to run three cars at the Easter Monday Goodwood meeting. Probably two of them will be the new rear-engined machines.

Palletisation Methods Applied to Parking



A model of the Motopark.

A new method of mechanical parking has been announced by Land and General Developments Limited. It is called Motopark and it is a completely automatic electro-hydraulic method which obviates all manual handling of the car either by the driver or by the attendant. When the car enters the Motopark, the brakes can be applied, the doors locked and the car is not touched again till he drives it away.

The illustration shows how a Motopark is built up. Of the cross-sectional area available, two-thirds are used for parking and one-third is a manoeuvring space in which a lift arrangement carries the cars to and from their parking spots.

When a car arrives at the Motopark, it is driven on to a dolly, which rests on a transporter, which rests on a lift. The attendant presses a button which corresponds to a vacant berth. The lift carries the car to the floor required: the transporter then carries the car and dolly along the central aisle until the car is is lined up with the selected berth (leaving the lift behind it). The dolly moves the car off the transporter into its berth and lowers it into position. The dolly then returns to the transporter and they both return to the lift to remove a car from the garage or to pick up another car from below. While the Motopark is designed to be fully automatic, certain manual operations can be introduced if required. Should there be a power failure, batteries installed in the building will keep things going. When the batteries run out, the Motopark can be operated manually.

Each transporter is designed to operate 60 units and the rate of discharge has been calculated to be one car a minute. This, of course, can be increased by adding more transporters.

Accurate Finish Lengthens Gear Life

Gears finished by commercial hobbing pit more rapidly than those finished by shaving. Better finished gears are also quieter, but the way noise is produced is not understood.

Research carried out at the National Engineering Laboratory, East Kilbride, shows the close relationship between gear wear and gear accuracy. So much so that an urgent need is indicated for further information on the allowable load in gears for a specific grade of accuracy. A summary of the work appears in a paper "Recent Developments in Spur and Helical Gears," by C. Timms, presented to the Institution of Production Engineers. Results obtained for wear rates in relation to gear speed are significant too. They are quite contrary to established practice based on British Standard specifications.

The main objectives of the NEL gear research programme are to determine the effect of dimensional errors and peripheral speed on load carrying capacity, and to investigate the compatibility of different gear materials with specific reference to gear deterioration.

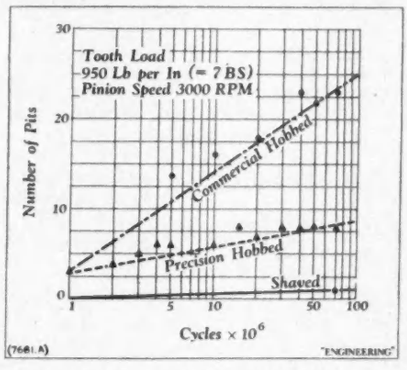


Fig. 1 Variation of pitting with finishing process used for gears.

A direct comparison of the results of gear tests carried out by different establishments is almost impossible. There is no accepted criterion of what constitutes surface failure both for pitting and scuffing. With regard to pitting, a great deal depends on the type of application. In many cases the appearance of one or two localised pits would not be regarded as sufficiently serious to justify replacement of the gears; yet this course of action would be called for on aero engine transmissions.

In the NEL investigation the method selected was to disregard pits smaller in surface area than about 1 sq. mm and to count all the rest as being indicative of surface damage. The appearance of the first four pits was taken to signify material failure, provided the pits were evenly distributed around the teeth of the gear. (Material failure does not imply gear failure, but complete failure was likely to occur if the tests continued under the same conditions of speed and load.) This arbitrarily selected criterion proved reliable in that all gears tested that satisfied the material failure condition showed a clear tendency to continue pitting with increasing load cycles.

The gears were tested in a conventional type of back-to-back rig, two pairs of identical test gears being attached to separate pairs of solid and hollow shafts. Torque is applied to the system when the gears are stationary by means of a lever arm and dead weights, through a flanged coupling. The drive consists of a 7½ h.p. motor and variable speed unit connected to the other end of the system through a flexible coupling. For the purposes of the experiment the gears were classified by the method of finishing—commercial hobbing, precision hobbing, or shaving. The average percentage contact marking for these three classes were 50, 56, and 80 per cent. The number of pairs of gears tested for each process was 32, 24, and 68. Details appear in the table.

The curves shown in Fig. 1 are representative of the damage occurring with each type of finish. In the tests the gears were run at a constant speed of 3,000 r.p.m. with a normal load of 950 lb-in—equivalent to 7 times the BS rating, assuming a speed factor of 0·23. The curves show clearly the relation between pitting resistance and dimensional accuracy and are typical examples of a large number of tests. They confirm that for a given material combination, the load rating in terms of the surface stress factor is related to the dimensional accuracy of the gears—a subject not covered in BS specifications for gears.

EFFECT OF SPEED

A further series of tests was carried out to determine the effect of speed on load carrying capacity. Sets of gears of equivalent dimensional accuracy, finished by shaving, were run at speeds of 750, 3,000, and 4,500 r.p.m. for a length of time corresponding to 40 million load cycles. For each speed the maximum load that could be carried without material failure was determined and is shown by the full-line curve in Fig. 2. The values shown were derived from tests on 68 pairs of shaved gears. From the slope of the curve it can be seen that the safe load carrying capacity of a gear pair increases with speed and that at a speed of 4,500 r.p.m. the load rating is about twice that at 750 r.p.m. A similar trend has been observed on gears finished by hobbing and suggests that the effect of dynamic loading due to pitch errors is either negligible, or is counteracted by other factors which tend to increase the allowable load with increase in speed. The results are quite contrary to established practice based on British Standard specifications for speed factor, for which the appropriate curve is shown dotted in Fig. 2.

This variation of load capacity with speed has been noticed by other people. In marine drives, for example, the secondary reduction gears usually show signs of failure earlier than the first reduction gears.

In practically all gear pairs, pitting started in a region immediately below the pitch circle of engagement; very little pitting appeared in the addendum of each gear. Apparently the pits started at the surface of the material: of the large number of specimens examined there was no indication of subsurface failure. It seems that the direction of sliding in association with the lubricant could account for the location of the pitted areas; but results obtained from disc tests at NEL do not confirm this. Attempts to correlate the results from gear and disc tests have not proved successful to date.

A series of tests on the efficiency of a gear transmission under different conditions of lubrication has also been undertaken at NEL. A speed reducing unit was used, comprising a set of spur gears: 8 D.P., centre distance 8 in, ratio 3 : 5. Tests were carried out with drip and spray lubrication, using a mineral oil having a supply temperature of 60° C and a viscosity of about 60 centistokes.

At full speed and load (pinion speed 2,000 r.p.m., pinion torque 200 lb-ft) the total torque loss with normal spray lubrication was about 1 per cent. About half of this was due to bearing losses. A change in the rate of sprayed oil from ¼ to 6 gallons per min did not affect overall efficiency appreciably. Losses were greatest when oil sprayed into the engaging side of the mesh, the increase in loss amounting to 0·5 per cent of full load torque.

In association with the research on load capacity, a series of noise tests was carried out on hobbed and shaved gears. It is generally agreed that with improvement in dimensional accuracy there has been a reduction in overall noise level, but there is no specific information on the actual causes of gear noise or what is regarded as an acceptable standard.

The NEL tests concentrated on obtaining frequency spectra of gear noise between 1 and 10 kc/s. It was found that the noise level at tooth contact frequency was substantially the same for hobbed and shaved gears, although there were marked differences in profile and adjacent pitch accuracies. This fact has been noted by other research workers and it appears that at tooth contact frequency the noise level is not necessarily dependent on gear accuracy.

The main difference in noise level occurs in the region of twice tooth-contact frequency. In the hobbed gears, this dominant frequency could be due to the inferior quality of the hobbed tooth profiles, in which the characteristic waveform of the profile graph was indicative of excessive hob eccentricity or cyclic error of the cutting edges. A more critical noise investigation of the shaved gears also revealed marked evidence of both frequencies and at higher speeds the high frequency content of the noise became clearly important. In these gears the profile measurement showed no obvious trace of a double flank wave pattern similar to the hobbed profiles, and the actual cause of the high frequency content is at present unknown.

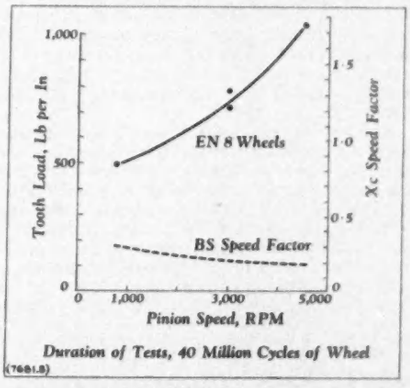


Fig. 2 The full-line curve shows the experimental results obtained for the variation of load carrying capacity with gear speed. It is contrary to the variation assumed as a basis for established practice (dotted curve).

The subject of gear noise is one of considerable complexity. A more critical examination than hitherto is required in order that the factors influencing noise generation might be assessed and guidance on methods of noise prevention provided. There is also ample scope for basic research on noise generated by mating pairs of discs operating under conditions of pure rolling, and with varying degrees of sliding. Evidence also exists that the damping effect of different material combinations influences noise.

Details of Gears Tested

Normal pressure angle	20°
Helix angle	25½°
Normal diametral pitch	10
Working depth	$\frac{2}{DP}$
Face width	0·8 in
Axial pitch	0·729 in
Gear ratio	$\frac{27}{38}$
Centre distance	3·6 in
Material combination	En 8 (wheel) En 9 (pinion)

Large Radio Telescope for Southern Hemisphere

Work on a new giant radio telescope, being built in Australia, has progressed so well that it is now almost certain that it will be in operation by the middle of 1961. Costing some £A600,000, this new telescope will have a reflector diameter of 210 ft and will be the most highly directional telescope of its type in the world. It has been designed for use on wavelengths between 10 and 20 cm.

Resembling, in general appearance, a huge paraboloid dish mounted on a tower it will completely dominate the typical Australian plains landscape near the small city of Parkes, 220 miles west of Sydney, New South Wales. When the rim of the dish is brought as close as possible to the ground, the overall height of the structure will exceed 200 ft. The dish, with its rotating gear, will weigh nearly 1,000 tons.

The tower consists of two inter-related, but physically independent parts: the outer tower, a three-storey steel and concrete building supporting the reflector and rotating gear and housing workshops and laboratories; and through it, a free-standing central pillar supporting a master equatorial unit.

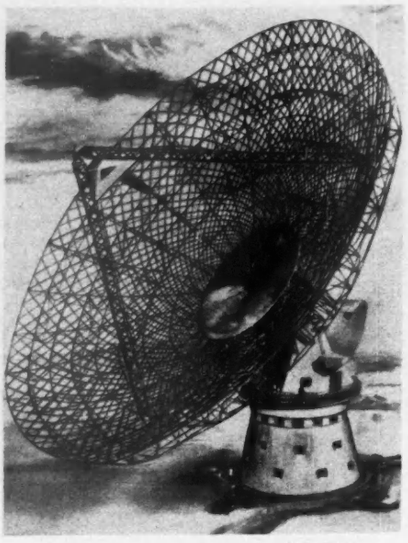
This unit, a revolutionary feature of the design, is an accurate polar axis, designed to fulfil the function of a first class optical telescope at the centre of the dish, keeping the instrument on its correct bearing. The big radio telescope will exactly follow the miniature axis operating under master control. No computations will be necessary.

The staff at the Sydney Radiophysics Laboratory, who will control this new telescope, say that they have benefited a great deal from the experience gained in the design and building of the Jodrell Bank telescope, which is still the largest in the world with its reflector diameter of 250 ft. The Jodrell Bank instrument is supported on two towers mounted on a circular rotation. The Australian instrument is of azimuth design, mounted on a single pedestal and it will be expected to have appreciably, greater precision.

The substructure of the Australian telescope consists of two concentric but separate cylindrical reinforced concrete towers. The outer tower, 39 ft in diameter and 42 ft high, carries the azimuth track and central lateral bearing ring on which the telescope is mounted, while the 10 ft diameter inner tower supports the steel azimuth pillar which passes through the lateral bearing ring and carries the master equatorial unit. Both towers are founded in hard clay 5 ft below ground level.

The outer tower is formed by a 9 in thick vertical wall of 39 ft outside diameter, which directly supports the azimuth track. It is built on a 12 in thick foundation wall with a 7 ft wide spread footing. Over its top 5 ft 9 in the wall thickness is increased uniformly to 3 ft 8 in to accommodate the track. At the ground level, a 7 in reinforced concrete floor slab is laid on 6 in of hard core, and at about 10 ft 6 in and 21 ft above the ground level, respectively, two beam and slab floors (the first 5 in thick and the second 7 in thick) are supported on columns built into the wall. All three floors have central holes through which the inner tower passes, leaving a half inch gap all round to be filled with fibrous packing and sealed with mastic. This tower is being erected as a free-standing structure to provide as rigid a support as practicable for the master equatorial unit.

The inner tower is formed by a 9 in thick vertical wall of 10 ft outside diameter built on a 12 ft diameter reinforced concrete base slab. Its floors correspond to those of the outer tower but terminate at the second floor level, where the azimuth axis pillar is supported. The first and second floors support the tubular steel column carrying the steel spiral staircase inside the azimuth axis pillar. When the outer tower is completed, a skin wall will be added as an insulation against the hot Australian summer sun.



An artist's impression of the giant radio telescope now nearing completion in New South Wales, Australia. Slightly smaller than the Jodrell Bank telescope, it will be the most directional radio telescope in the world.

When complete, the telescope will present a total weight of about 1,400 tons to its foundations, and will have cost some £A600,000 to construct. The Rockefeller Foundation and the Carnegie Corporation, both of the United States, each contributed $250,000 towards the cost, bringing the total funds available for this project to approximately £A750,000.

Oil-Ash Corrosion of High Temperature Alloys

A report describing tests carried out to study the effects of fuel-oil composition and of metal and combustion-gas temperatures on the oil-ash corrosion of high temperature alloys has been issued. The report was given in the form of a paper, which was recently read before the American Society of Mechanical Engineers at its annual meeting in Atlantic City, New Jersey, USA.

According to the report, most of the corrosion data already published has been obtained in conditions where the temperature of the combustion gases and the metal were about equal, whereas in the experiments described these temperatures were varied so that boiler-operating conditions could be simulated. These temperatures, and fuel composition and firing conditions were closely controlled. The alloys tested were AISI types 304, 310, 316 and 321, in the form of welded tubes. Tests were also made on the effects of additives in reducing corrosion.

The report states that none of the four alloys was outstanding in its resistance to corrosion, though type 310 has a somewhat promising performance at the higher temperatures. The effects of fuel-oil composition on corrosion were shown graphically; further work on other fuel compositions will enable previously published data to be adjusted for different combinations of combustion-gas and metal temperatures.

It was found that fuels containing less than 10 parts per million of vanadium produced much less corrosion than other fuels which contained 150 parts per million, or more, of vanadium. The influence of sodium is said to be less than that of vanadium. Additives fed as a dry powder reduced corrosion at a metal temperature of 1,200° F; a relationship is given between optimum additive content and vanadium content.

Measuring Fallout Patterns Quickly

To keep a check on variations in the level of backgound radiation, the Atomic Energy Authority Research Group have fitted out a vehicle with a scintillation detector and recorder. They find the best arrangement is to fit the detector on top of a 10 ft pole attached to the offside of the front bumper. During surveys a speed of about 20 m.p.h. is maintained.

This equipment would be of particular value in the event of an accident at a nuclear establishment which releases radioactive material over the surrounding countryside. A rapid picture of the amount and location of fallout can be obtained by the vehicle if the background radiation has been measured before the accident. There is the alternative of flying detection instruments over the suspect area in a specially fitted aircraft; but this calls for a large organisation, is rather expensive, and needs good flying conditions. Thus a Series II Land Rover with a 10 ft pole attached to its bumper can be expected over a good few British roads this year.

The detector used is a transistorised scintillation ratemeter, running off a torch battery. It is compact a instrument, being fully sealed and dessicated in a box 12 in by 7 in by 4 in. The detector, a sodium iodide crystal, is mounted in the front bottom of the box. On its most sensitive range the instrument will measure 0-15 microroentgen per hour. It feeds a shock-proof recorder.

Previous surveys have been carried out with the detector in the vehicle. Putting it on a pole has the advantage that the detector can " see " a greater area of the country side, with less obstruction by hedges and banks, and makes it less sensitive to changes in road surface materials. The vehicle itself becomes a smaller percentage of the area viewed by the detector and so it is of less consequence if the vehicle becomes contaminated after driving through an area of fallout. Also the detector is carried nearer the middle of the road, which makes it independent of which way along the road the vehicle is going.

Road repairs introduce anomalies if the detector is mounted inside the vehicle. It is common for pipes, cables, and drains to be laid down one side of the road, and the excavated materials are not always returned to the trench in their original order. Also there is often an importation of " foreign " material, such as hard core, or tarmacadam. As a result, the radiation background can vary from one side of the road to the other, even as much as 40 per cent.

Flameproof and Dustproof Electrical Equipment

For almost 30 years now, the Electrical Research Association has been working together with the Safety in Mines Research Establishment on the problems of using electrical equipment in inflammable atmospheres. Since 1956, as a direct result of an increased demand for flameproof and intrinsically safe apparatus (particularly from the oil and chemical industries), the range and pace of this research has been extended.

Under the heading of " flameproof equipment," research into the use of a new and much more rigid apparatus for safe-gap determination has shown that the safe-gaps for group IV gases (such as hydrogen and water-gas) are greater than has hitherto been supposed. This means that it may now be feasible to construct flameproof equipment which is safe for use in these gases. Possible alternative methods of construction, such as the use of gaskets, are also being investigated.

Specific items of research, such as the determination of the relative strengths of clear and acid etched well-glasses for flameproof light fittings have also been carried out recently by the ERA, at the request of the British Standards Institution.

Work is now near completion on an experimental dust chamber which may form the basis for a standard method of testing the dust tightness of electrical apparatus—a more difficult job than it looks. This test has in fact been provisionally adopted by the BSI as the basis of its proposed specifications for dust-tight electrical equipment.

This technique for dust measurement involves placing the test piece in a chamber (see illustration) in which a dust cloud is formed by air jets. Since the test requirement is normally that all dust should be excluded, an extremely fine micro talc is used and the test piece is considered dust proof only if no dust at all is found inside after the completion of the test.

To simulate realistic conditions, which often involve a reduced pressure inside the container of the electrical equipment, the test piece is connected to a vacuum line. Other test variables such as the average pressure difference between the dust atmosphere and the atmosphere inside the equipment, and the effects of various particle size distributions in different dust-laden atmospheres, are now being investigated.

This work is controlled by an ERA research committee and is carried out by the ERA at their laboratories in Leatherhead, Surrey, and by the Safety in Mines Research Establishment at Portobello Street, Sheffield 1.

The dust-tightness of electrical equipment can now be tested under controlled conditions in this experimental dust chamber, developed and built by the Electrical Research Association.

Energy for Hypersonic Wind Tunnel

An energy storage system is now being manufactured by the Westinghouse Electric Corporation, in the USA, which will allow investigations to be carried out into the thermal and aerodynamic properties of missiles and aircraft at velocities of 9 to 24 times the speed of sound and at simulated altitudes of 100,000 ft, or even higher.

Westinghouse reports that the energy storage system will power a hypersonic impulse wind-tunnel (commonly known now as a " hotshot " tunnel). Four basic sections, an expansion-cone/test section, a vacuum reservoir, an arc chamber and an energy storage system comprise the entire facility. Westinghouse is to build the energy storage unit, which will eventually go to the McDonnel Aircraft Company, St. Louis, USA.

The system has the capacity to deliver electrical power at the rate of almost 2½ million kilowatts. This is far greater power than can be delivered steadily by any known generator and it will, of course, appear only as an impulse of energy, covering the brief period during which the wind-tunnel will be worked for any particular test.

In the completed wind-tunnel, the arc chamber will be separated from the tunnel tank by a thin diaphram. Prior to a test, the arc chamber will be filled with a highly compressed gas, while the tunnel-tank is evacuated to an extremely low pressure (which would be of the order of 10^{-6} mm Hg, or even lower).

When a model is set up in the test section of the apparatus, electrical power from the energy storage system is then delivered to the arc chamber. This causes a tremendous increase in the temperature and pressure of the gas in this chamber and so vaporises the diaphragm which previously separated the arc chamber from the tunnel tank.

The high pressure gas, which may well be at about 10^5 lb per sq. in and 14,000° F, then expands through a tungsten throat, producing hypersonic velocities in the test section of the wind-tunnel.

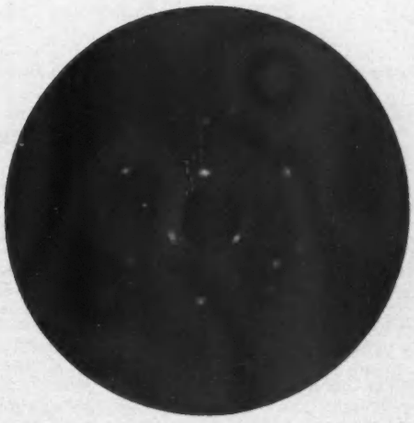
Extending the Life of Industrial Diamonds

Industrial diamonds are comparatively rare and expensive materials, and in recent years there has been a considerable increase in the demand for them. Many people are interested in the research being conducted to determine how these stones can be used to the greatest advantage.

An interesting result of this type of research has recently been reported by the N.V. Philips Gloeilampenfabrieken, Holland, in the *Philips Technical Review*, No. 6, vol. 21. The report points out that a diamond has the longest useful life when it is given a very specific orientation in the tool since, in a single crystal, many physical properties are not the same in all directions.

For example, the resistance of a diamond to wear shows a pronounced anisotropy. If, then, a cutting diamond is so positioned that the direction along which the workpiece moves coincides with the direction of greatest wear resistance, a quite considerable extension of the useful working life of the diamond may be achieved. Sometimes the life of a tool is not so much threatened by wear as by cleavage. In this case a different, but nevertheless very distinct, orientation will be called for.

It has long been known that the directions in which the physical properties of a crystal exhibit their maxima and minima are related to the structure of the crystal, and that to be able to set a diamond for optimum tool performance it is necessary to know something of the orientation of its crystal lattice. Sometimes this knowledge can be determined by visual inspection but, more often than not, it is necessary to resort to X-ray diffraction techniques.



The X-ray diffraction pattern, or Laue diagram, of a diamond can now be viewed directly by using the Philips X-ray image intensifier.

X-ray techniques have always produced very good results, but only at the cost of a fairly considerable amount of highly valuable man hours. This is because the diffracted X-ray beams are too weak to produce any kind of directly visible image, so that the analyst must wait until photographs can be developed before he can make any comment on the orientation of the crystal. In fact, an accurate determination can only be made by trial and error techniques, involving quite a number of photographs.

Now, as a result of research carried out at the Philips laboratories in Eindhoven, an X-ray image intensifier is available which enables direct viewing of the diffraction diagrams. This means that the process of orienting diamonds need only take a few minutes, instead of several hours, and can be done by semi-skilled operators.

This new technique of orientation is described in the Philips report as follows: The diamond is fixed to a goniometer head that can be remotely controlled by an operator/observer behind the image intensifier. The observer then alters the orientation of the diamond until he sees the desired type of spot pattern (illustrated), appears on the viewing screen. The diamond is then ready for transfer to the tool.

Garbage Problem

Oil and gas fired central heating systems are clean, convenient and very efficient. So are electrical systems and the modern solid fuel boiler. But nice as they are they impose a limitation that did not exist with the old type of solid fired boiler—you cannot burn rubbish on them.

The disposal of domestic rubbish and garbage is now becoming an ever more pressing problem, particularly as more and more flats are built, without even the chance of a good bonfire now and then. The old dustbin outside the back door may not have been over-hygienic (especially in the fly ridden summer) but at least it provided an answer. As houses become increasingly converted to flats the rows of dustbins outside increase yet they still can be used. But in more modern purpose-built flats they are not practicable, particularly for waste food products that quickly become offensive. The result was the central incinerator—all right for a time but now liable to contravene the Clean Air Act, and by no means fitted everywhere.

The problem has been acute for some time in the United States where oil fired central heating is so much more widely used than here. Moreover rubbish is only collected every three or four weeks in many places, as against the usual weekly collection here. As a result special incinerators have been designed for the particular purpose of consuming rubbish, and one of them—the Caloric, a gas fired unit—is now being made in England.

The Caloric has the advantages of being completely automatic, capable of disposing of any type of waste, requiring only a simple flue, and complying with the Clean Air Act. Once the combustion is initiated the unit is locked until the cycle is complete.

Waste, wet or dry, is dropped in the lid, a maximum loading level being marked on the inside. When it is desired to start combustion, the lid is closed and the knob turned to the lock position. The timing device is then set to the appropriate value according to whether the waste is dry, medium or wet, the action locking the lid and the door of the ashpit. Neither can be opened until the full time has elapsed.

Air enters through the louvres at the top of the unit and passes downwards through the waste. The gas jets are arranged around the fire bars at the bottom and the products of distillation are carried through the flames and entirely burnt. The burnt gases pass up an auxiliary combustion chamber, where the rest of the smoke is consumed and subsequently up the flue where they are mixed with cold air drawn in from outside so that they leave the chimney clean and comparatively cool. As a result a 6 in heavy asbestos flue is sufficient or alternatively the outlet can be connected directly into a brick stack. The incinerator can be installed inside or outside the building.

The Caloric is a comparatively large unit having a door opening 11¼ in square and standing 36 in high. The capacity for waste is 2 cu. ft. The gas input is 32,000 Btu per hour and lighting is by pilot jet. The jacket is insulated by glass fibre faced by aluminium foil.

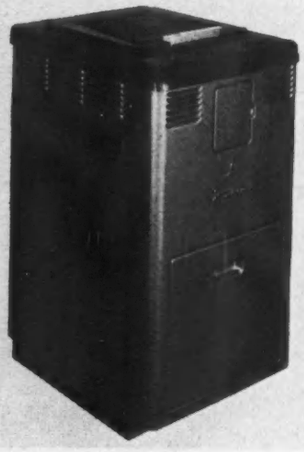
High temperature alloy steel is used throughout the construction apart from the grates, which are of cast iron. Porcelain enamel is the finish on the doors and exterior. The ash drawer has a capacity of 800 cu. in and is fitted with a handle. As the jacket is air cooled the incinerator can be installed without special protection.

While quite suitable for domestic installation, the Caloric is also large enough for use in hospitals, schools or factories as a central disposal unit for rubbish collected from the kitchens and cloakrooms. Organic matter can be burnt without producing smells or smoke.

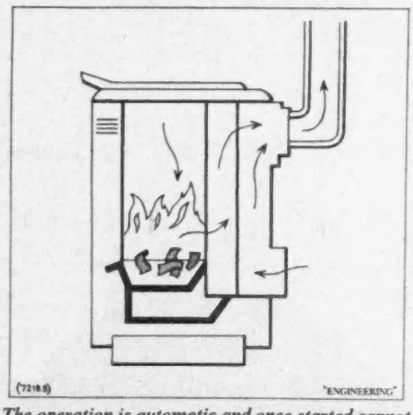
For installations in cloakrooms, or for multiple installations where a central uniti s not convenient, there are several small wall mounting incinerators. They are available with either gas or electric firing and give complete combustion of even wet material. In the electric models operation is usually initiated by pressing a button, so they can be left unattended. Doctors' or dentists' surgeries can use the smaller units.

An entirely different method is proving popular for the disposal of kitchen waste. It has the advantage that the waste does not have to be collected and loaded into an incinerator, both actions requiring time and some planning, as well as a little effort if the incinerator is not immediately to hand. Instead the waste is merely allowed to go down the drain of the sink.

The Wastemaster disposal unit fits on the sink outlet in the normal waste pipe. It consists basically of a shredder that accepts all normal kitchen waste, and reduces it to particles small enough to pass through the ordinary drainage system. The unit will accept such items as small bones, eggshells, crab shells, vegetable scraps and fibrous materials, including pea pods, carrot tops and the like, as well as fats and greases from frying pans. In fact all the debris formed from preparing and consuming a meal.



The Caloric is a gas-fired incinerator for disposal of all organic or inorganic waste.



The operation is automatic and once started cannot be interrupted. Combustion is absolutely complete.

The Wastemaster fits to the sink in place of the normal U trap. Below the shredder is a fractional horse power electric motor to drive it, and the outlet is from the side. As a result little or not alteration to existing plumbing is required. In action the waste is scraped from the plates into the sink, the water turned on, and the motor started. Water consumption is said to be about 1½ gallons per day per person and electricity used is negligible. Drain pipes should be not less than 1½ in diameter and should be as short and smooth as possible and have the minimum of bends. Operation is quite satisfactory with a septic tank providing the latter is not smaller than 500 gallons capacity.

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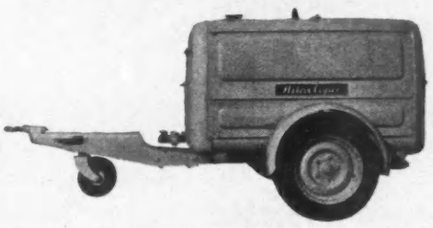

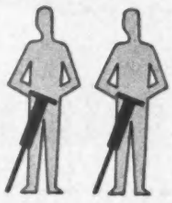

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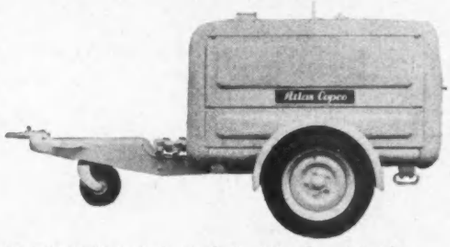

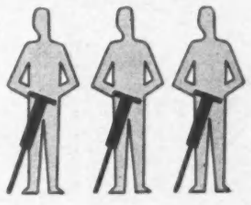

Weight 2,310 lb (1,050 kg) ★ 160 c.f.m. 4.5m³/m

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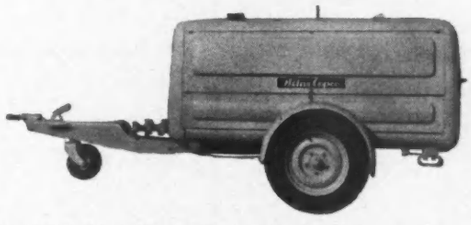
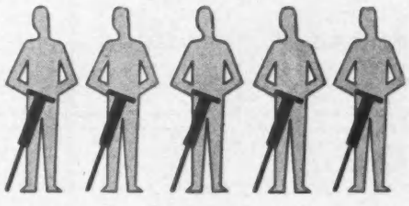
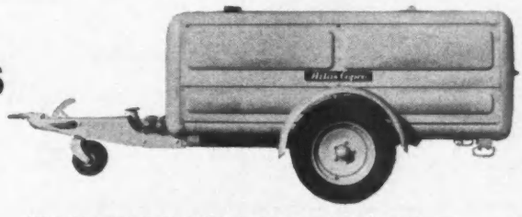
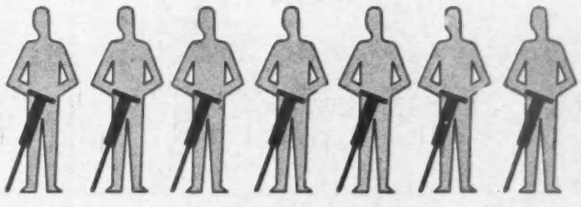




Weight 2,900 lb (1,315 kg) ★ 225 c.f.m. 6.4m³/m

VT6





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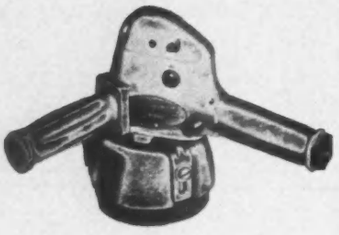

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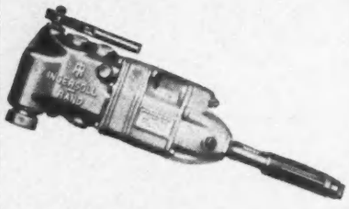

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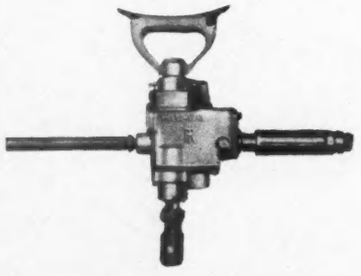

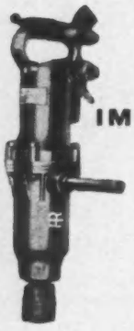

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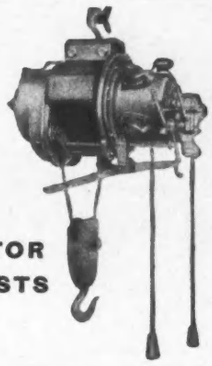

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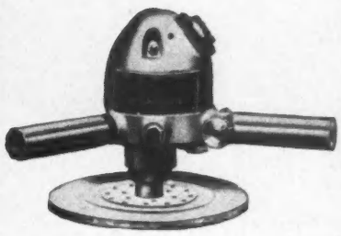

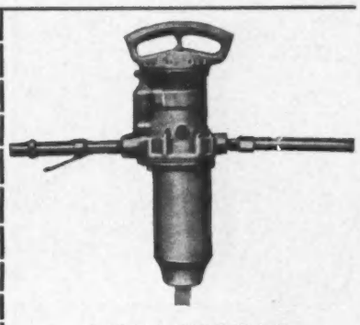

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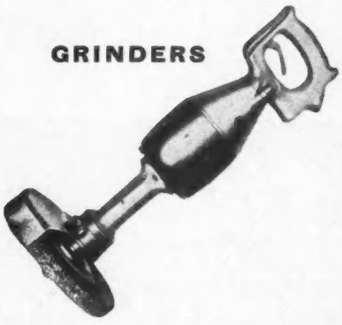

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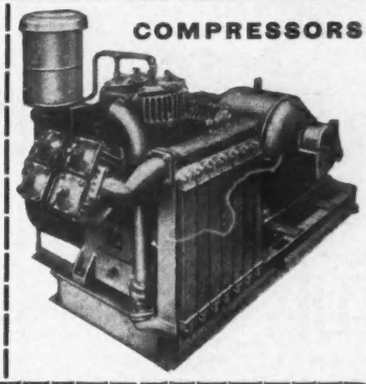

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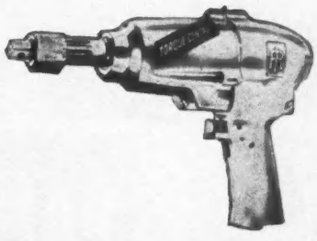

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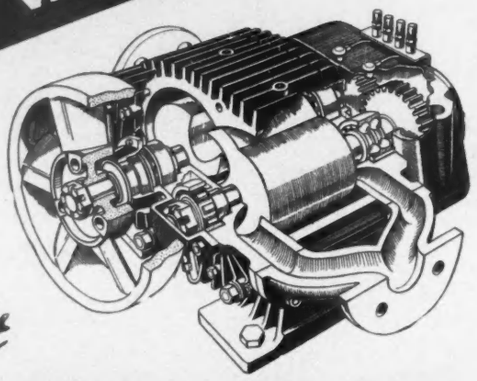

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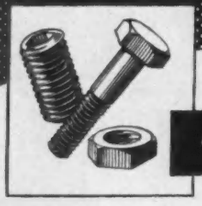

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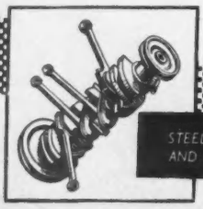

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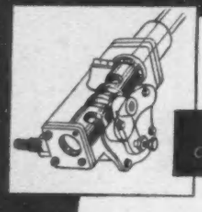

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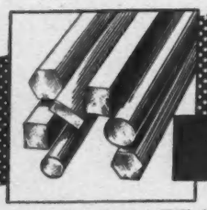

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The leads must hold their points and flow smoothly throughout a long line – no crumbling or 'clinkers' mark you! – and if I erase a line it must go cleanly – there's no 'furrow' left in my paper so you won't find ghost lines in prints made off my drawings. As a matter of fact you can tell from a print when it is my drawing – the print's always first class".

"What pencils do I use?"

"Venus drawing pencils of course, the ones with the crackle finish! – how else do you think I keep my high standard?"

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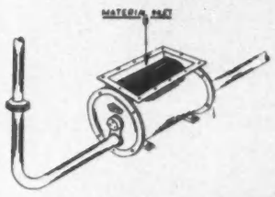

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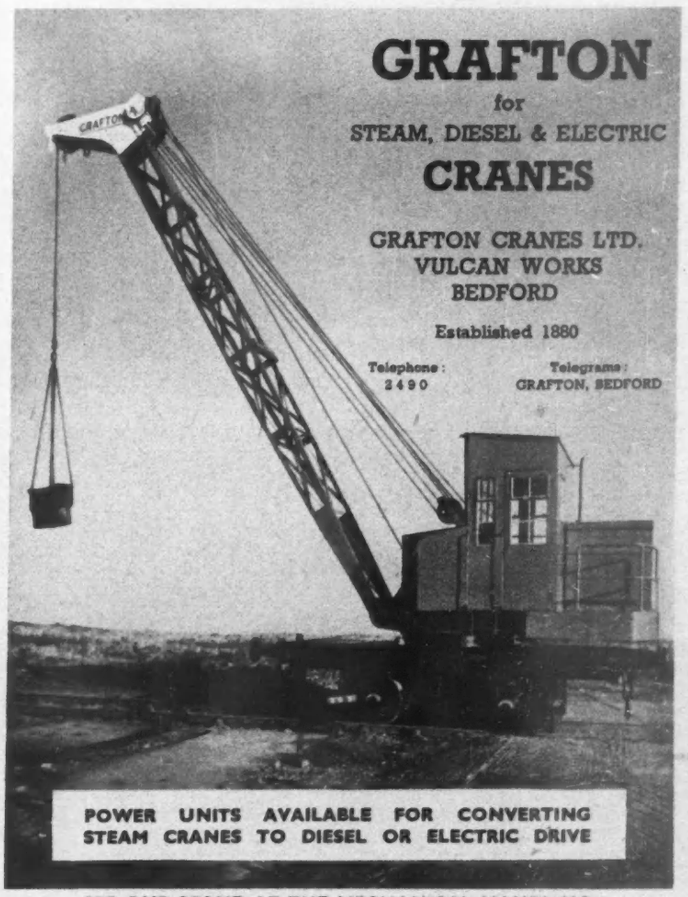

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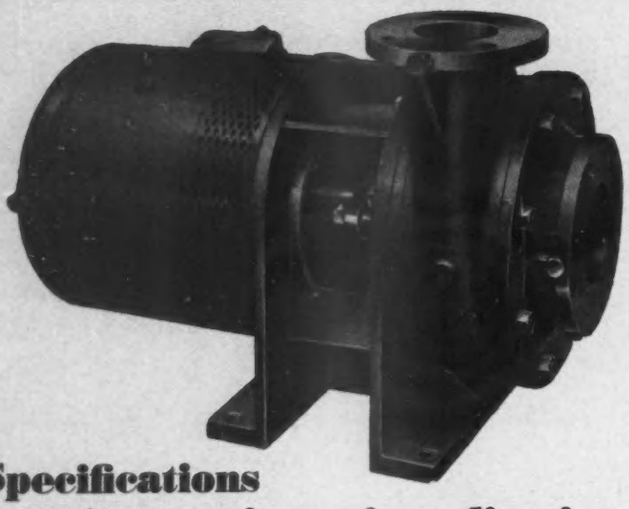

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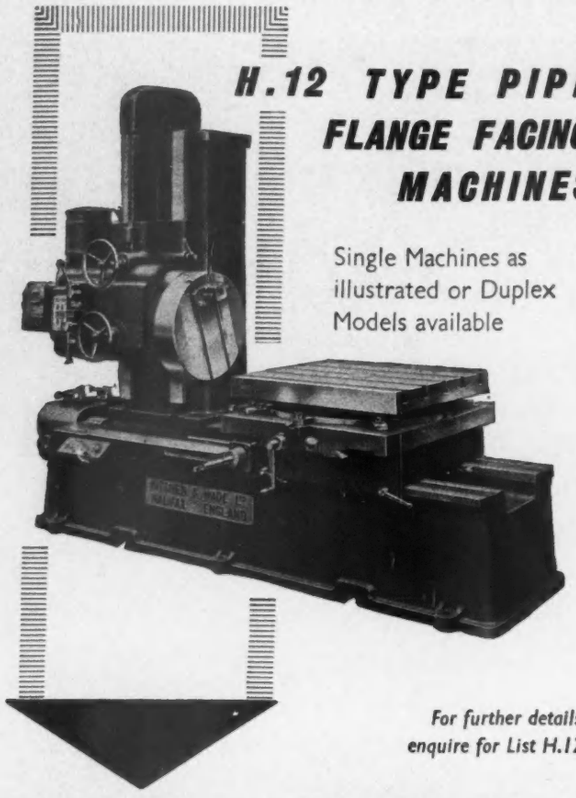

H.12 TYPE PIPE FLANGE FACING MACHINES

Single Machines as illustrated or Duplex Models available

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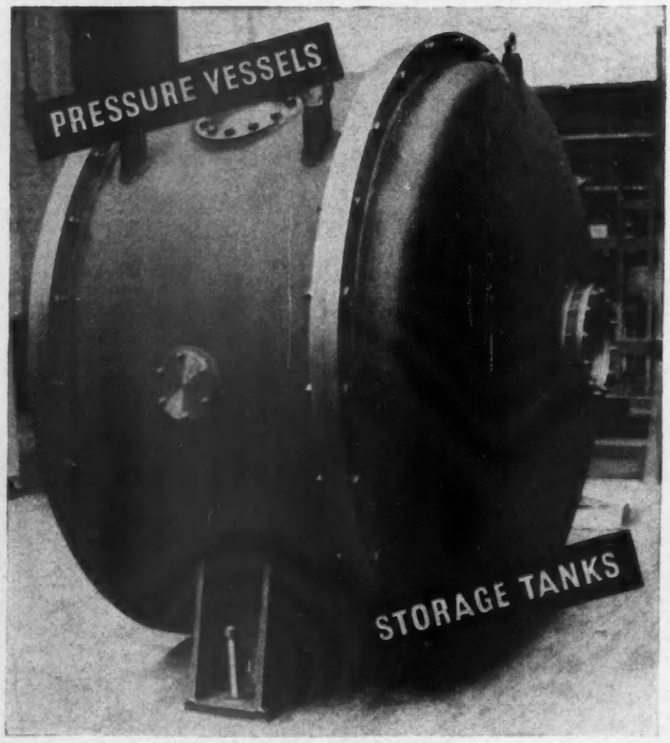

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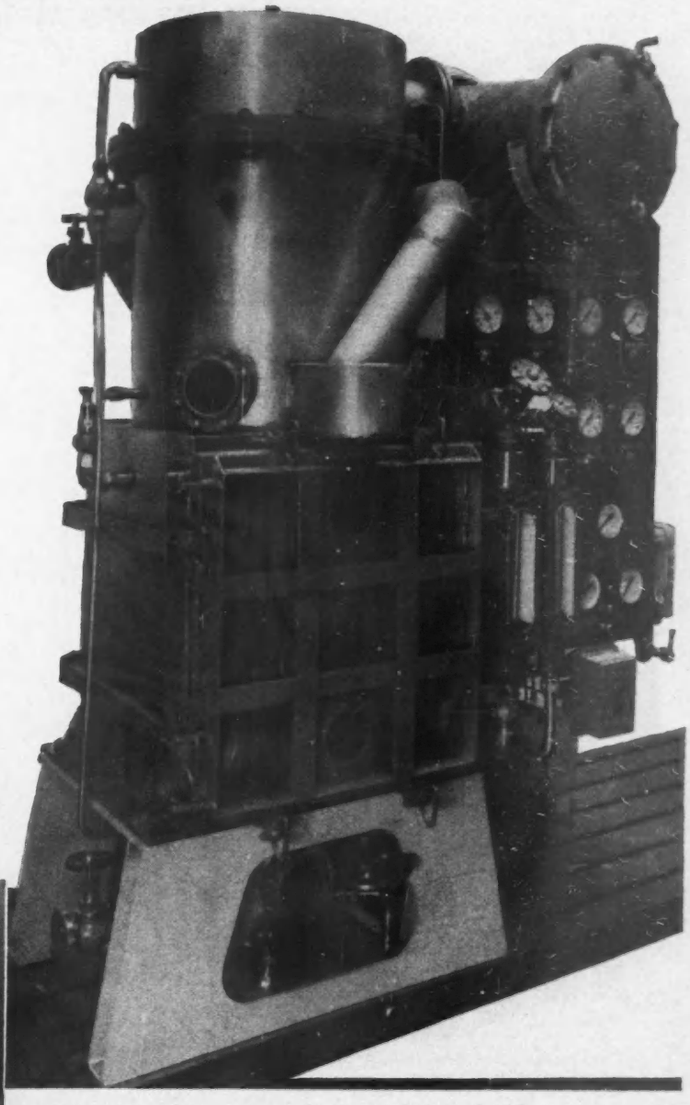

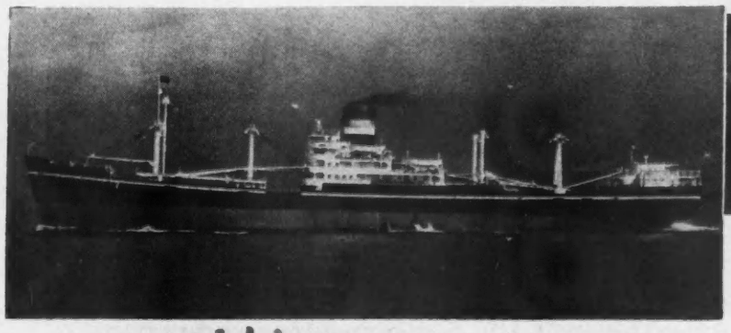

(Above) This Maxim L120D Unit gives an output of 37 tons of fresh water daily. Monel is used for the evaporator shell and the heating element to withstand boiling brine, waste steam heating and "cold shock" treatment.

(Left) The M.S. "Maturata" (7365 tons gross), Messrs. Thos. & Jno. Brocklebank Ltd., which is fitted with Maxim distilling equipment.

*TRADE MARK

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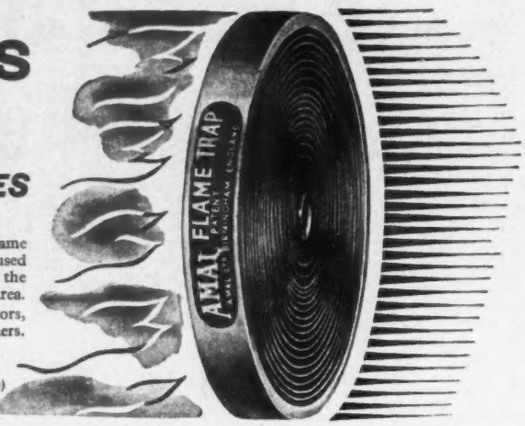

● Flame Traps for fitting into pipe lines carrying an explosive air-gas mixture will hold the flame for a limited period until a cut-off valve comes into operation. Little resistance to the flow is caused by the use of these traps. List No. 526 describes various models and gives the pressure drop for various flows per square inch effective trap area.
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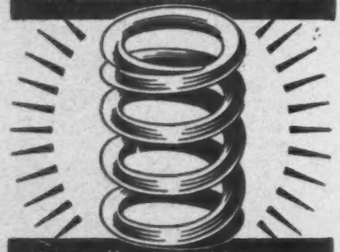

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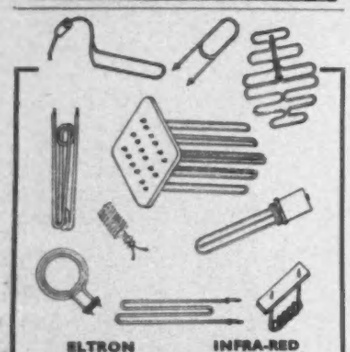

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JOSEPH ADAMSON
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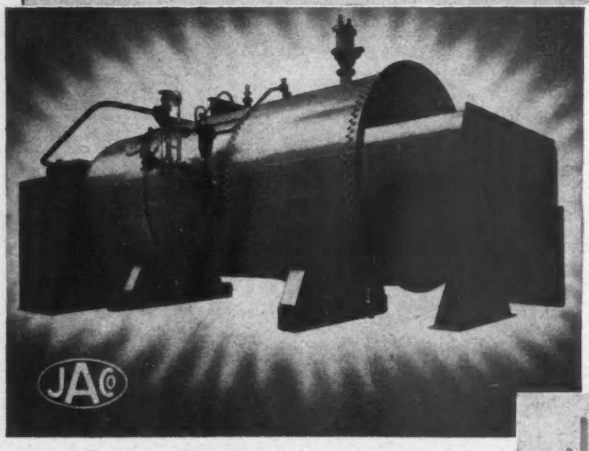

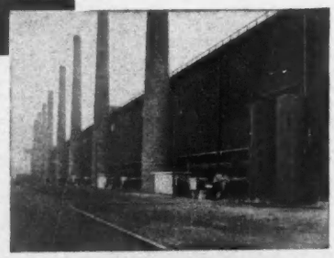

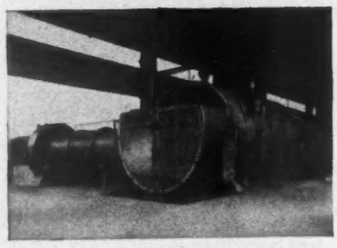

The Joseph Adamson Waste Heat Boiler is designed to make efficient use of the waste gases leaving open-hearth furnaces, reheating furnaces, soaking pits, gas retorts, etc.

The straight-through fire tubes have a high ratio of length to bore, giving about 90% tube efficiency and providing a large area of heating surface in a comparatively small space. Brickwork setting is not required and air infiltration is thus avoided.

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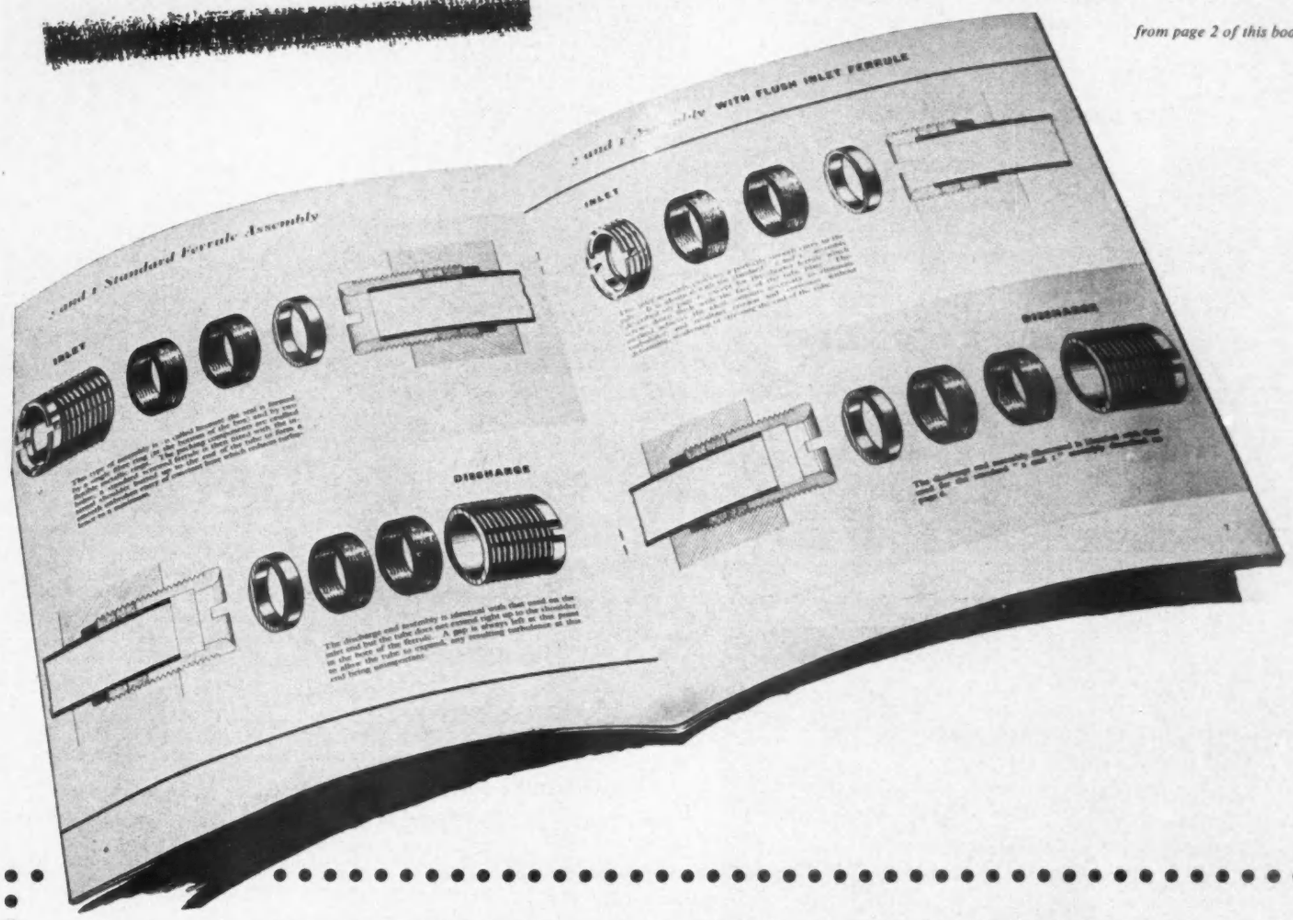
JA 11

Quote!

"The CRANE Condenser Process was developed so that the tubes of conventional straight tube heat exchangers might be secured and effectively sealed off in their tube plates, while still allowing them freedom to move axially—**without deformation or damage to the tube ends.**"

from page 2 of this booklet.



This is a booklet which has been produced for all engineers who are concerned with the manufacture or the performance of straight tube heat exchangers, and especially marine and land based condensers.

The contents of the booklet include a description of the CRANE Condenser Process, the problems which arise in sealing against leakage in all conditions of marine and land service, descriptions of various assemblies, and other information which is allied to the subject.

Copies of the CRANE Condenser Process Booklet can be obtained from Crane Packing Limited of Slough, Bucks, England.

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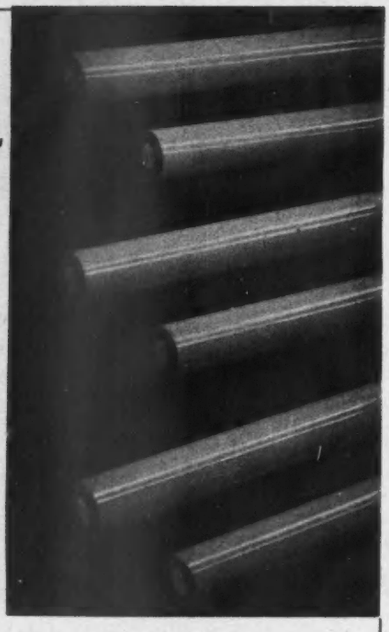

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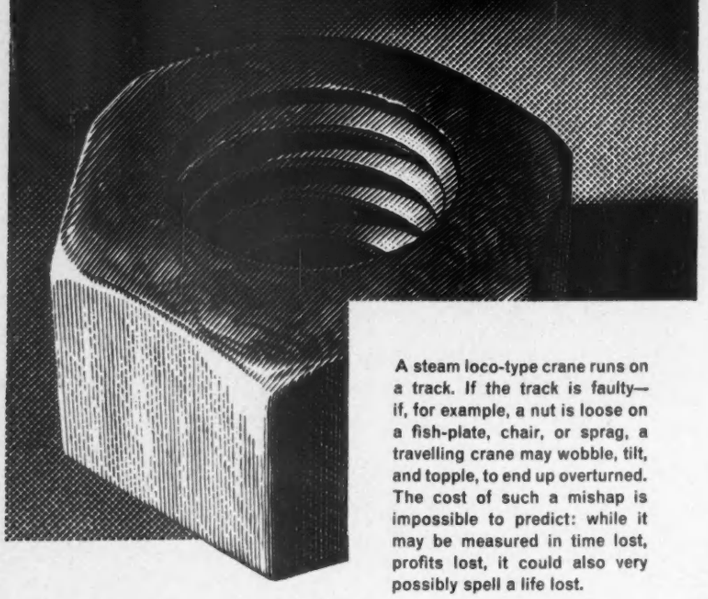

A steam loco-type crane runs on a track. If the track is faulty—if, for example, a nut is loose on a fish-plate, chair, or sprag, a travelling crane may wobble, tilt, and topple, to end up overturned. The cost of such a mishap is impossible to predict: while it may be measured in time lost, profits lost, it could also very possibly spell a life lost.

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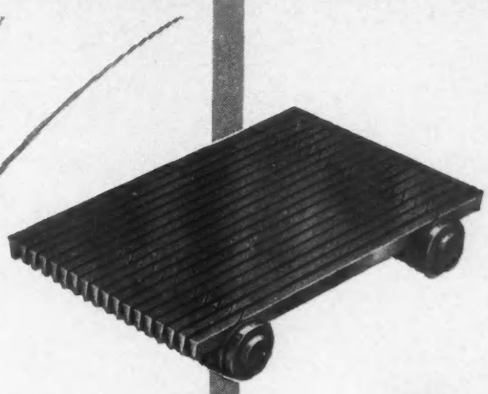

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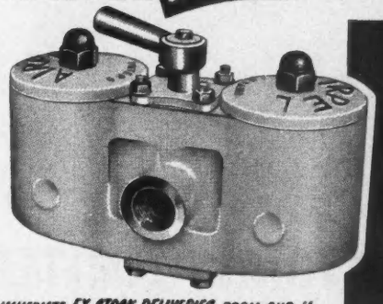

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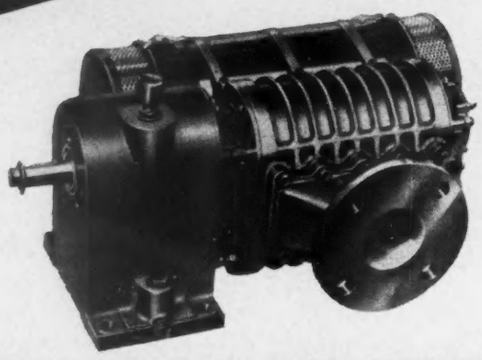

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2750	450	10	*
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2750	400	12	†

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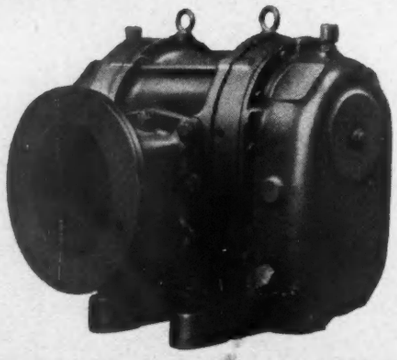
M-2000

Speed rpm	Airflow cfm	Pressure psi
1500	750	3
2200	1000	10



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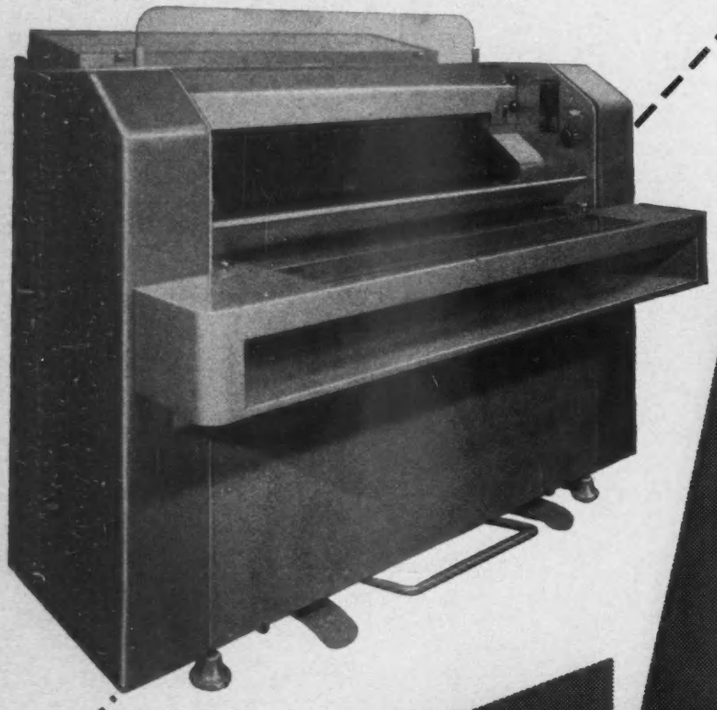

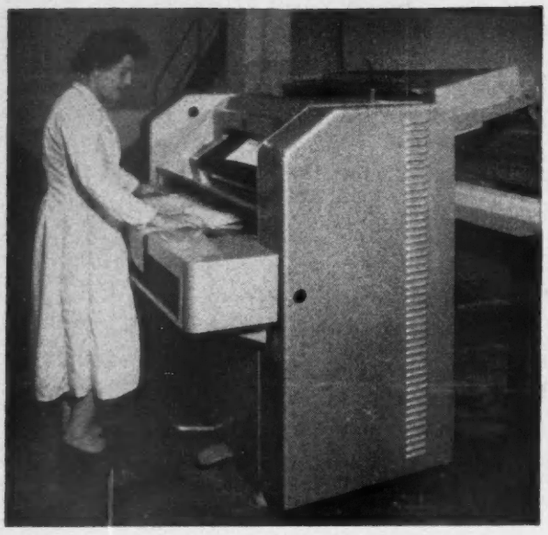

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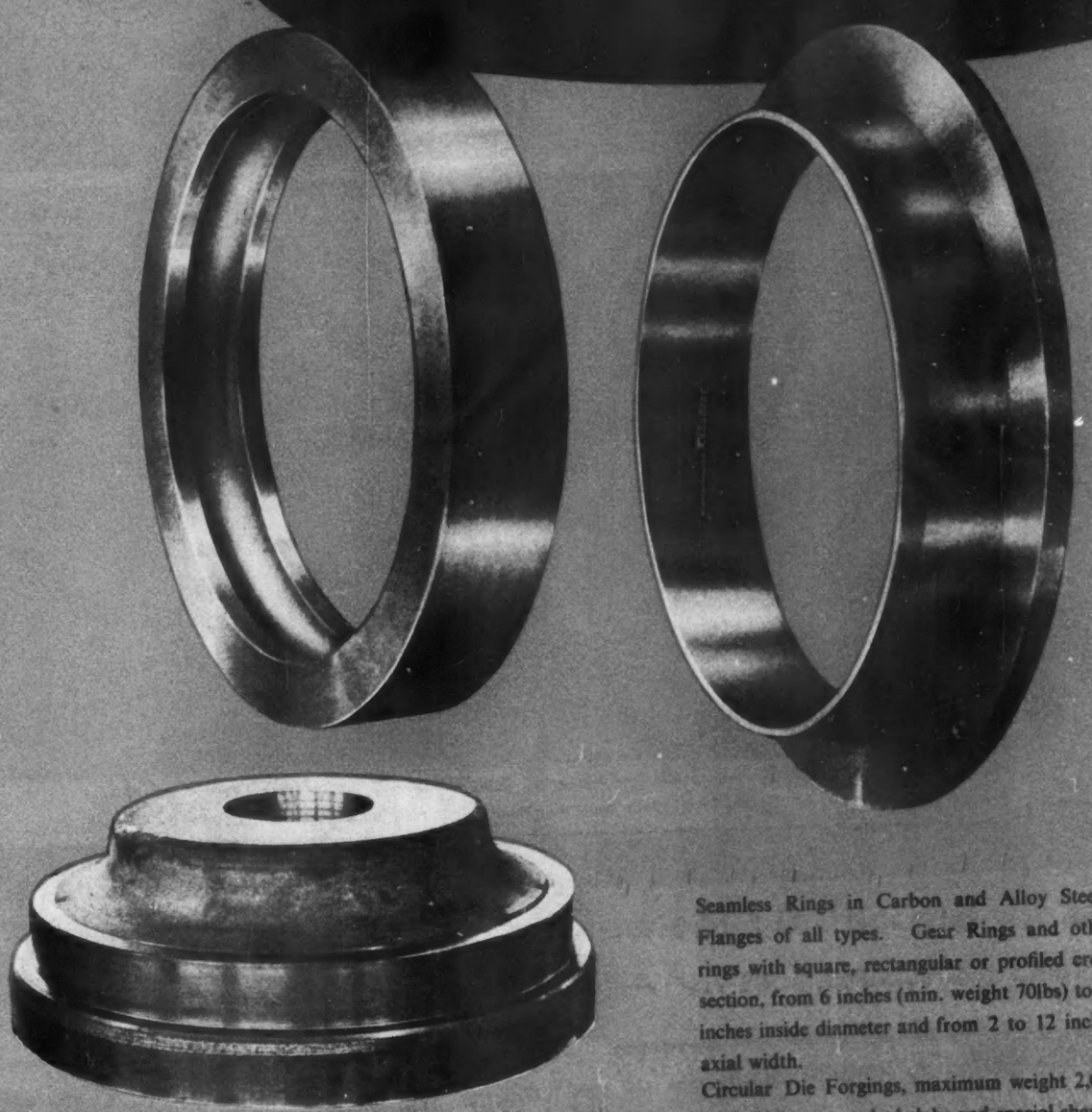

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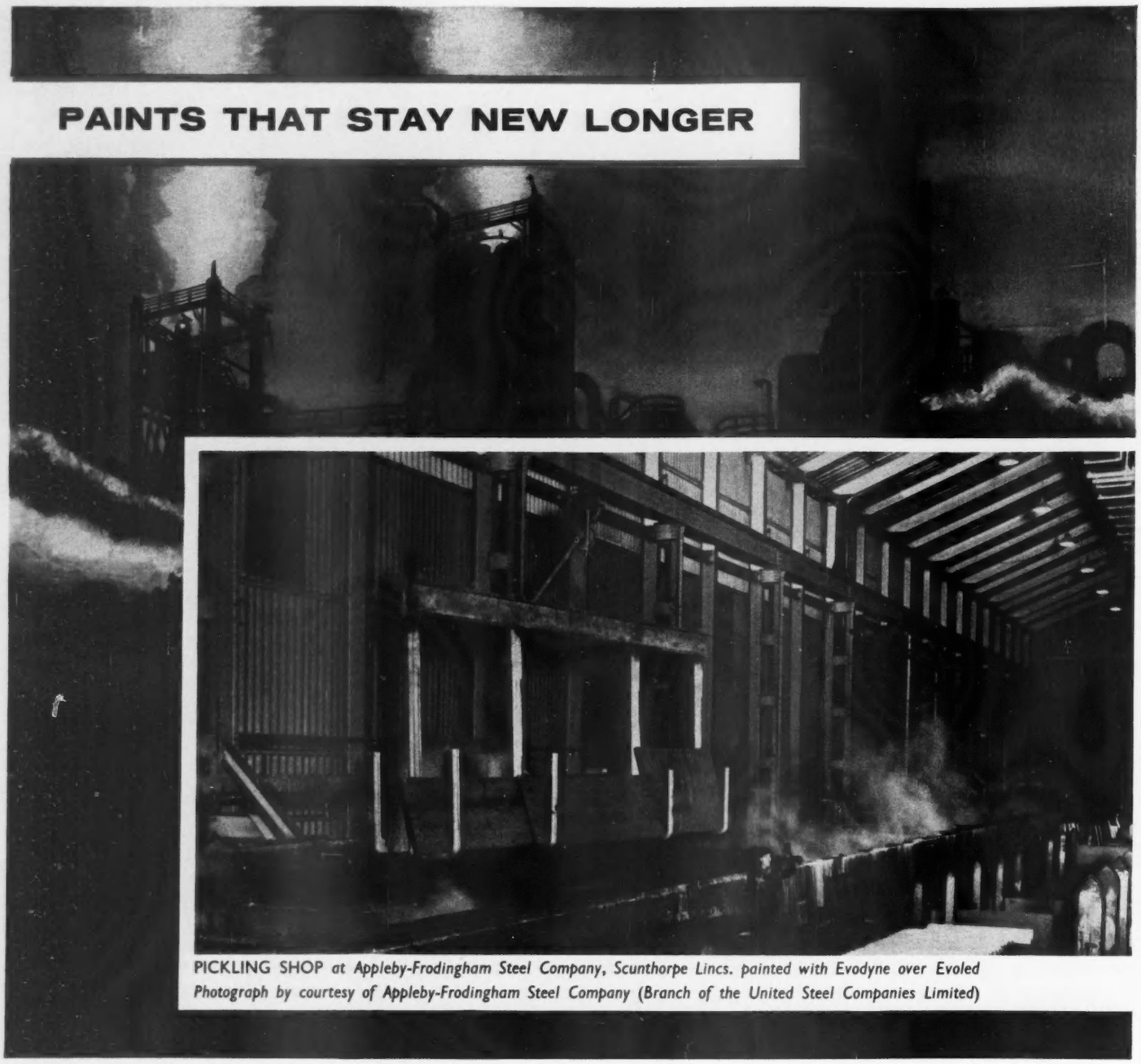

PICKLING SHOP at Appleby-Frodingham Steel Company, Scunthorpe Lincs. painted with Evodyne over Evoled
Photograph by courtesy of Appleby-Frodingham Steel Company (Branch of the United Steel Companies Limited)

Paints for Structural Steelwork in Industry must be tough—
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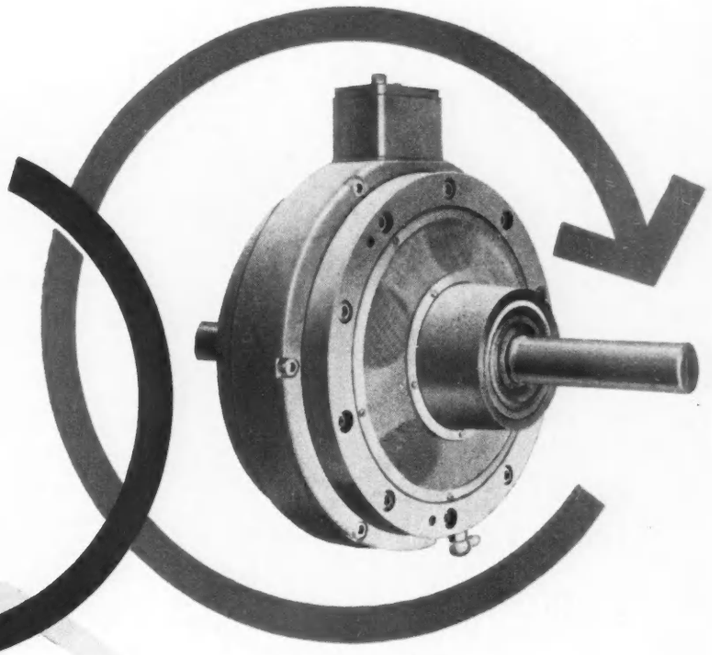
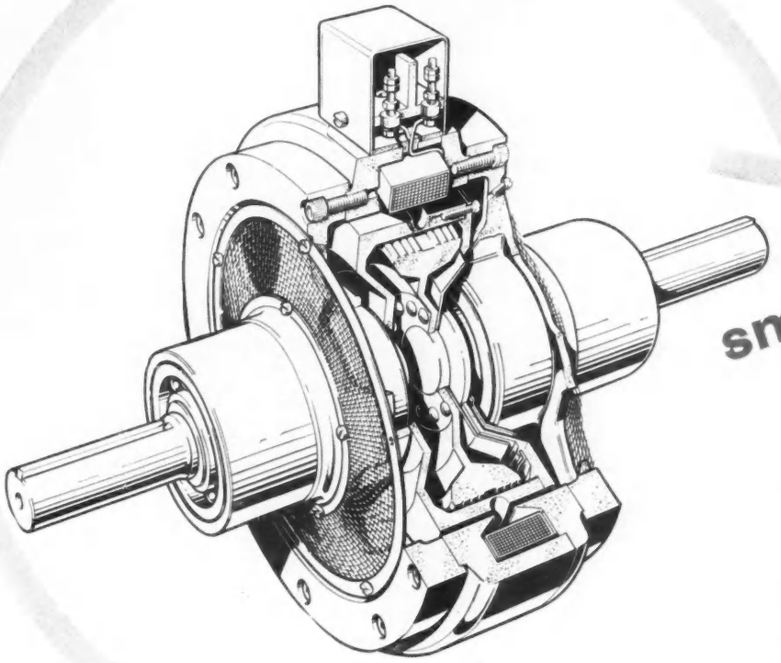
H-W.179

SMITHS

Magnetic Particle

COUPLING





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Smooth as a hydraulic coupling, but without the drag, positive as a friction clutch but never needing adjustment for wear, SMITHS magnetic particle COUPLING provides accurate control of torque without complications. It acts as a coupling or brake in either direction and can be remotely controlled from any distance.

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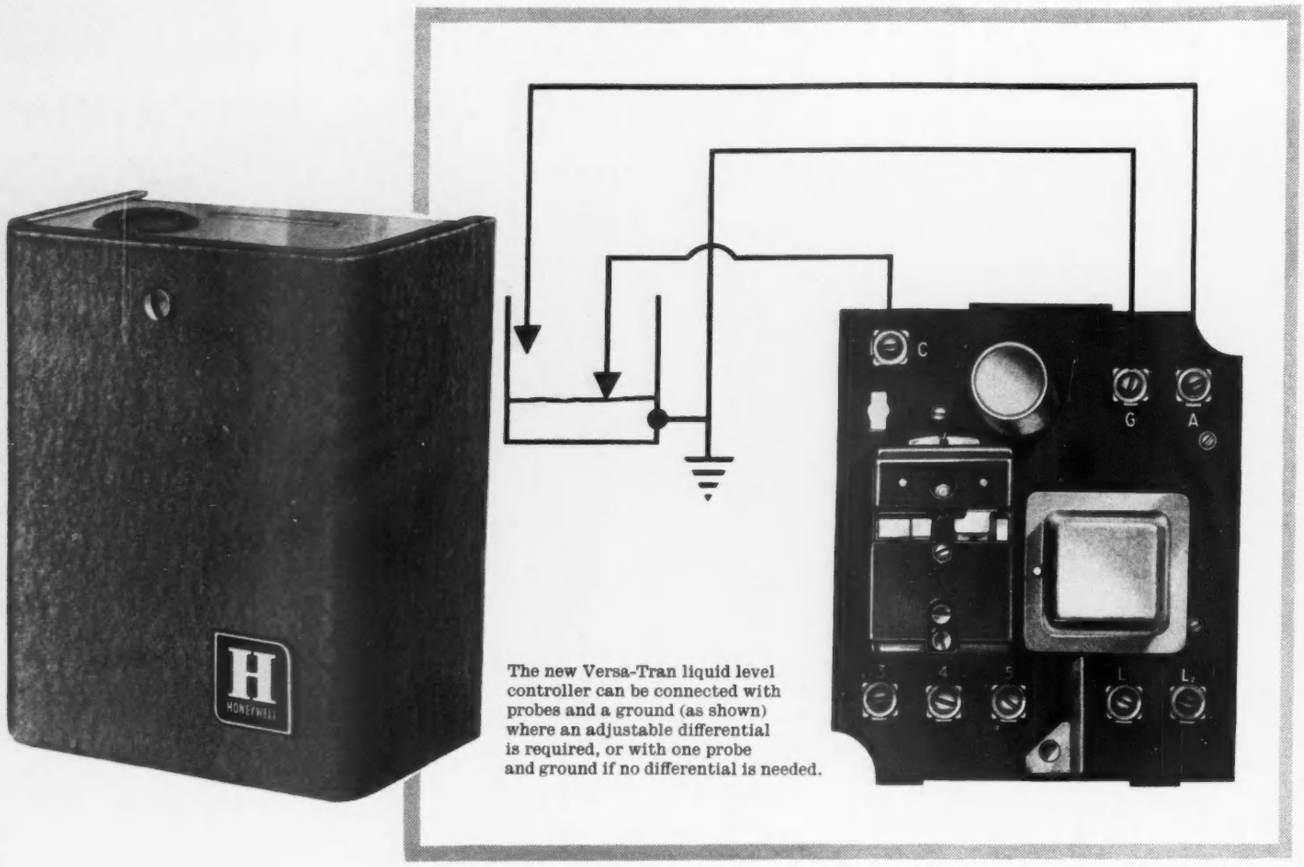

The new Versa-Tran liquid level controller can be connected with probes and a ground (as shown) where an adjustable differential is required, or with one probe and ground if no differential is needed.

New low cost, high precision VERSA-TRAN simplifies liquid level control

Here's a simple, easily installed electronic controller that accurately controls the level of any electrically conductive liquid with a measured impedance not exceeding 25,000 ohms, measured at the probe-type sensing element. Its features include:

- unique, fully transistorised design which eliminates the need for field adjustment and calibration.
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- no floats or standpipes necessary.
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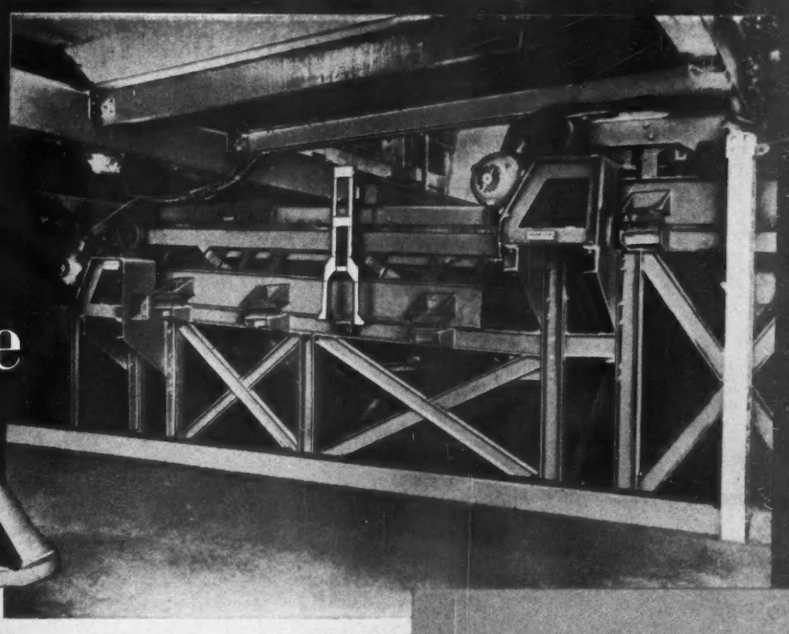

Cushioning the shocks stops metal fatigue

Maintenance on screens at the Lynemouth (Northumberland) colliery has been greatly reduced by the application of Metalastik anti-vibration mountings.

The Lynemouth washery is one of the largest single units in the United Kingdom and large amounts of coal are handled per hour on screens operating several hours a day. In February 1956, the No. 1 Primary Spray Screen and the No. 1 Primary Drainage Screen were placed on Metalastik Cushyfoot mountings.

Vibration and noise were immediately reduced.

Cushyfoot mountings are of particular value for mounting screens as they permit the greatest movement in the direction most needed, i.e. along the length of the screen, relieving the screen frame and holding-down bolts from stress.

VIBRATION DAMPING

Metalastik vibration cushioning devices range from those for sensitive instruments and internal combustion engines right up to those meeting the heaviest shock loads of industry.

FLEXIBLE BEARINGS

Silent, unlubricated and resilient, the various forms of Metalastik bushes for permitting pivotal movement have been well-proved by the millions in successful use.

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A wide range of Metalastik couplings covers practically every requirement, catering for every kind of misalignment and damping out torsional fluctuations and shocks—some also transmit axial thrust.

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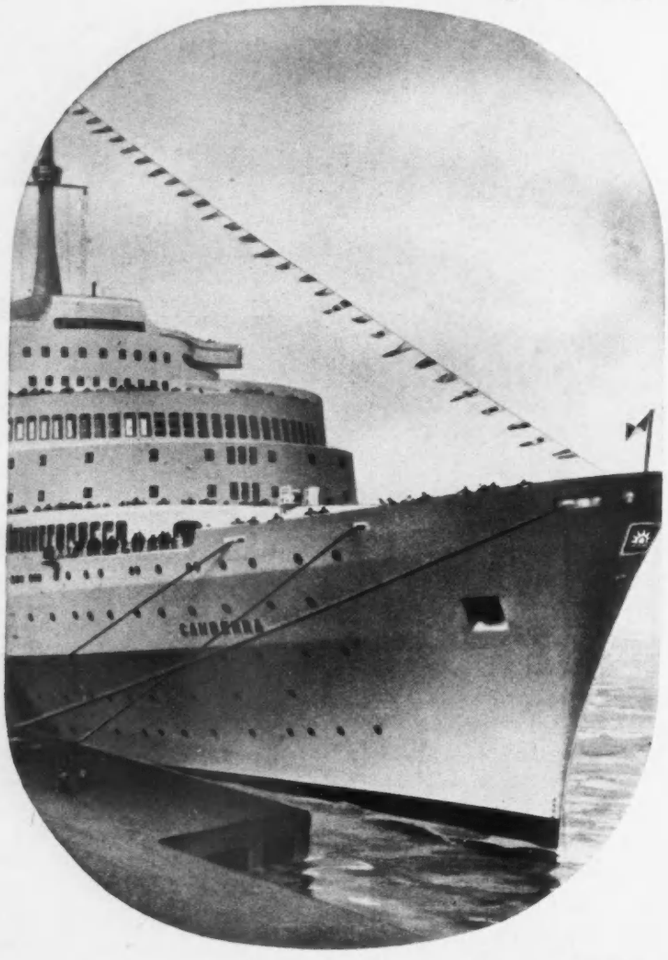

- **Anchor cable and warping capstan gear to handle bower anchors and 3.5/8″ steel cable, also driving port and starboard warping capstans.**
  A patent electronic warning device for safe housing of anchors is incorporated.
- **Forward centre line warping capstan.**
- **Aft windlass to handle the stream anchor and 2.1/16″ steel cable driven from aft centre line warping capstan.**
- **Aft port and starboard warping capstans.**
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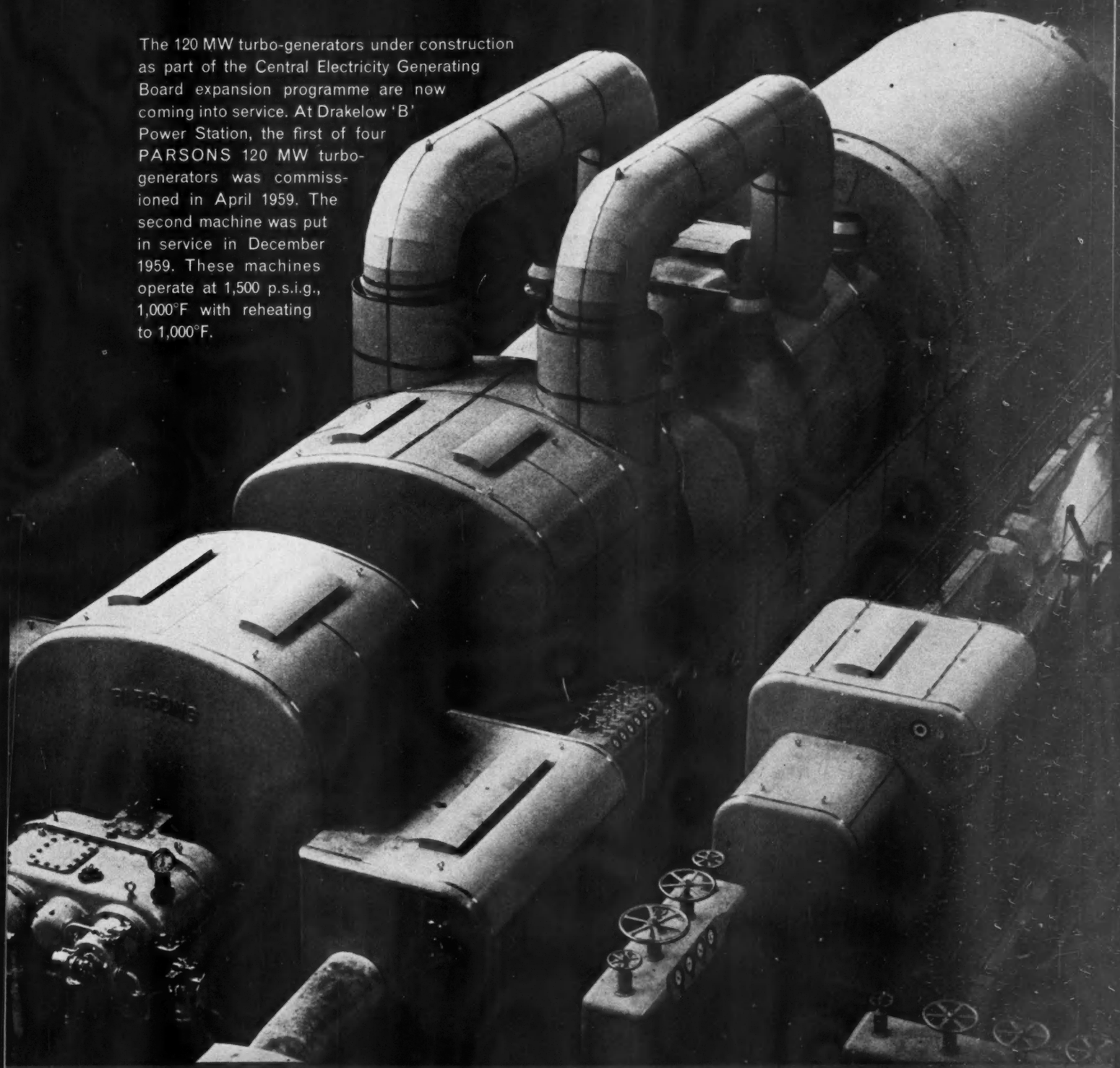
S45

POWER ....another "120 MW" now generating

The 120 MW turbo-generators under construction as part of the Central Electricity Generating Board expansion programme are now coming into service. At Drakelow 'B' Power Station, the first of four PARSONS 120 MW turbo-generators was commissioned in April 1959. The second machine was put in service in December 1959. These machines operate at 1,500 p.s.i.g., 1,000°F with reheating to 1,000°F.



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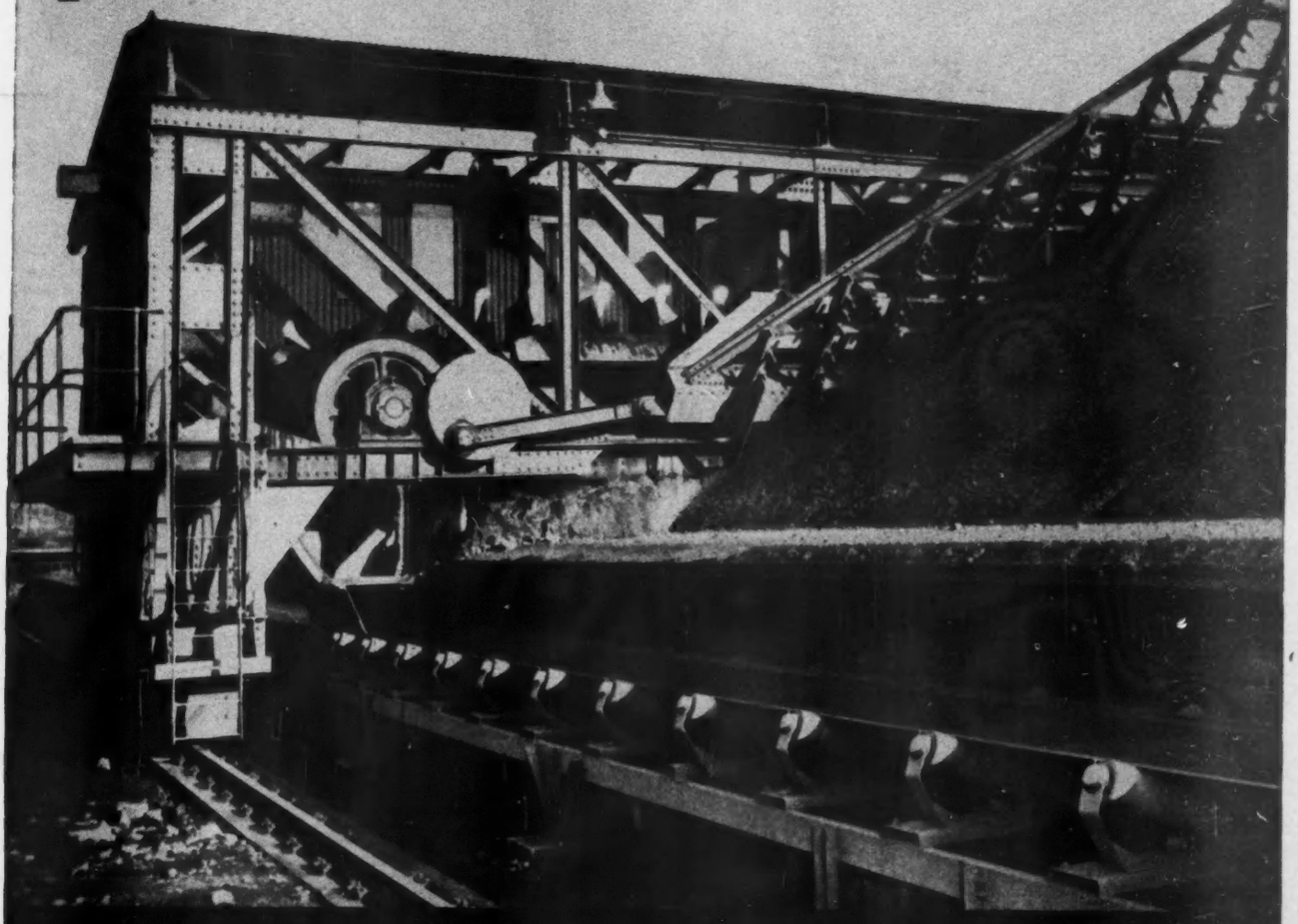
Europe, too, takes its materials handling problems to G.E.C.



In modern blast furnace practice the blending of ores and coals is often essential. Robins-Messiter reclaimers of the latest G.E.C. design are meeting this very purpose all over the world.

The G.E.C. Erith Works specialise in the design and manufacture of complete ore and coal preparation plants. This includes conveyors, screens, crushers, stocking-out and reclaiming machines, wagon tipplers, sampling plants, bunkers and buildings. In fact, G.E.C. installations, handling and processing materials to and from sinter plants are dealing with capacities of 3,000,000 tons per year or more.

The G.E.C. have installed complete ore handling plant in the U.K., Belgium, Italy, Spain, Yugoslavia, Africa, Australia, etc. They are always pleased to advise companies contemplating such systems—especially at the pre-planning stage.

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Designers and manufacturers of complete materials handling plant.

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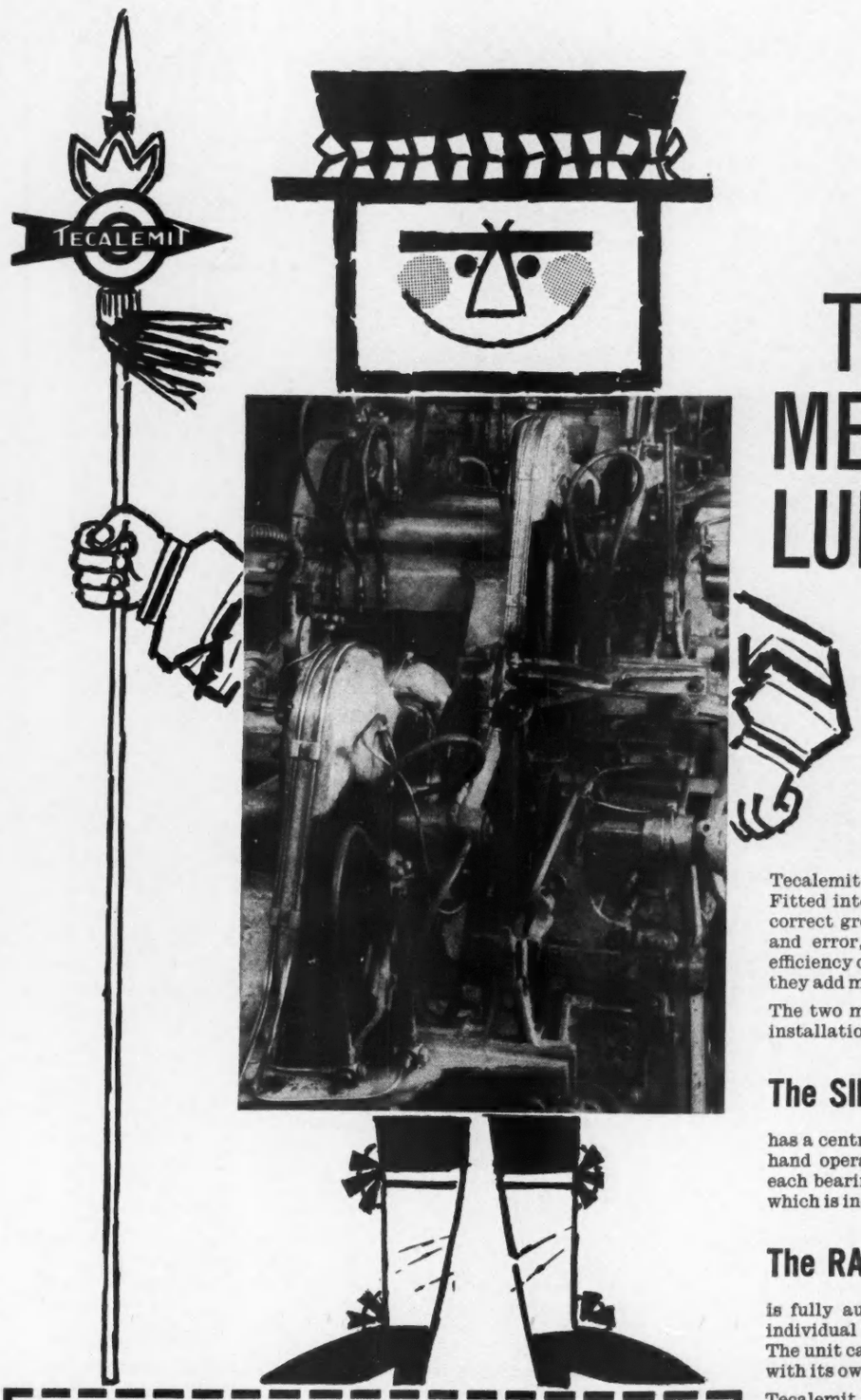

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is fully automatic, and uses 19 miniature pumps to serve individual bearings. Each pump's output is pre-regulated. The unit can be driven from the machine it serves, or supplied with its own electric motor.

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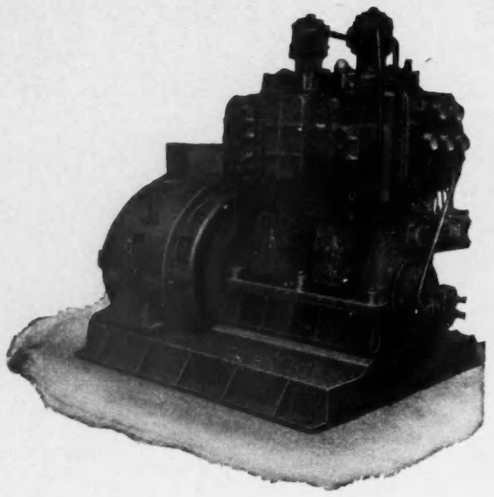

This shows our latest 3-stage Vertical Enclosed Marine Type Diesel Auxiliary Compressor, with Forced Lubrication, direct coupled to an Electric Motor. Machines may also be arranged for Steam Driving, and have either one or two cranks, depending on the output.

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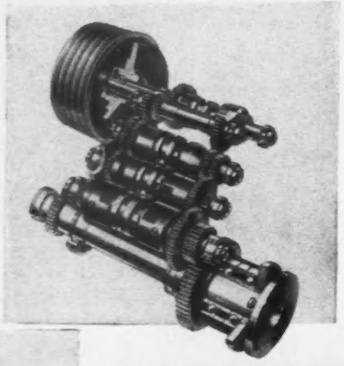
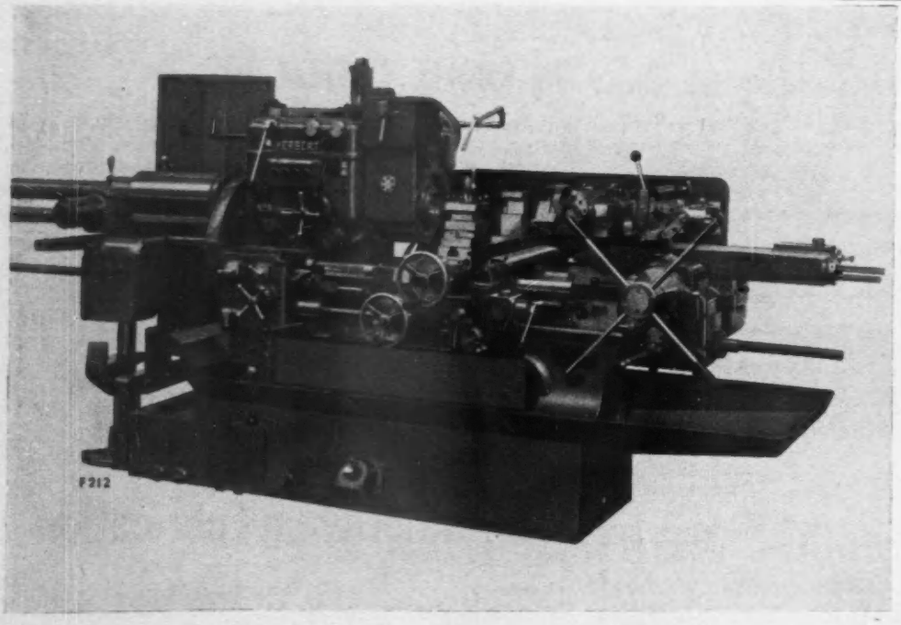


Shaft and gearing arrangement of power-operated Preoptive head-stock. Hardened and ground gears close to bearings to minimise shaft deflection. All speed changes by multi-friction clutches. Multi-vee rope drive giving high efficiency.



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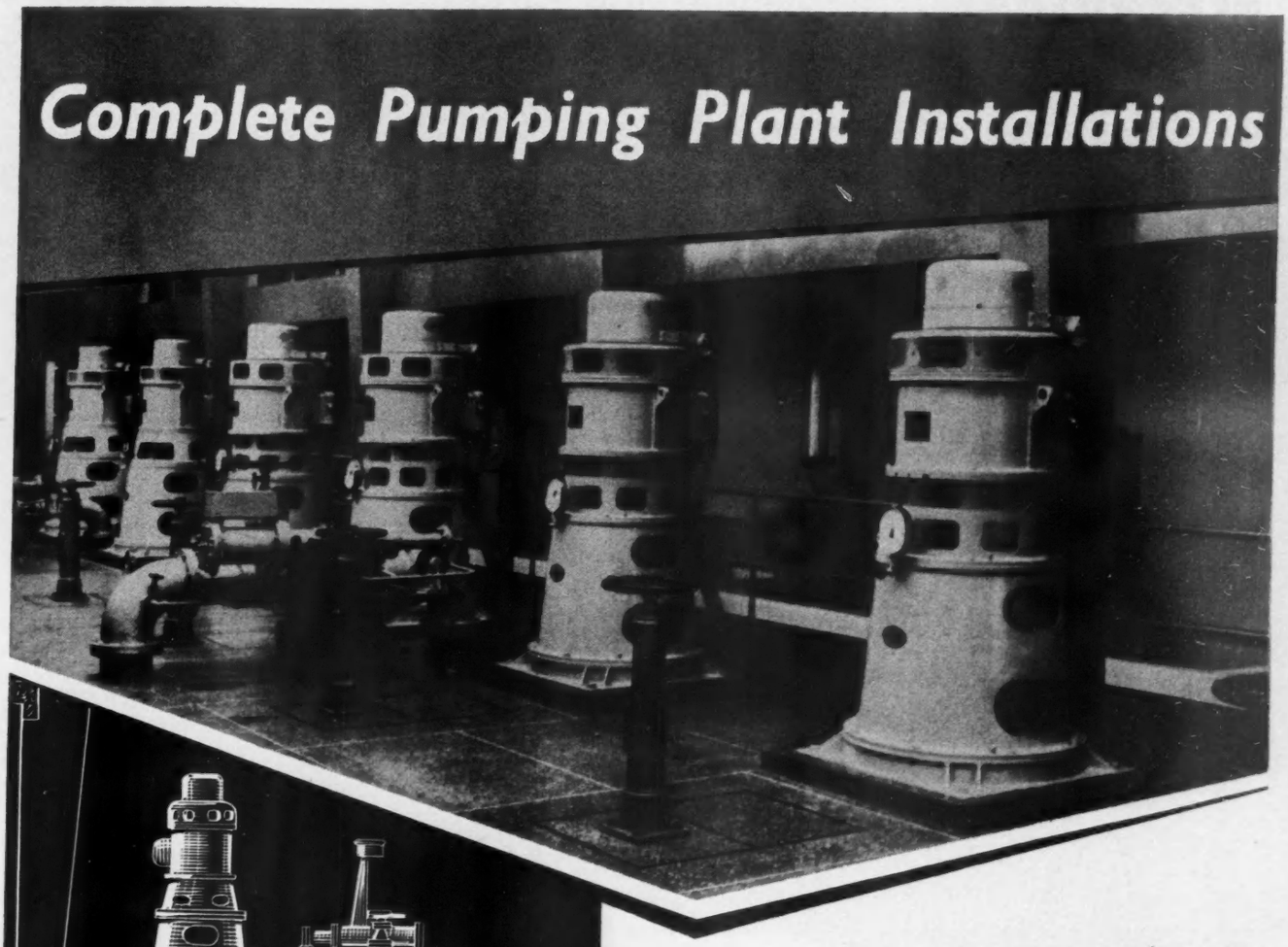

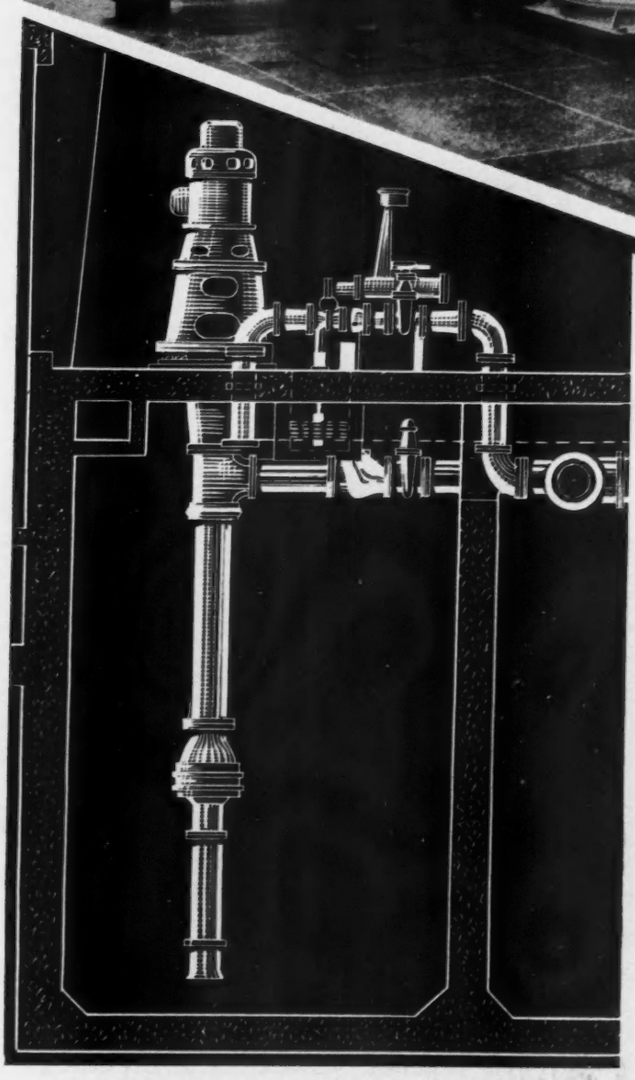

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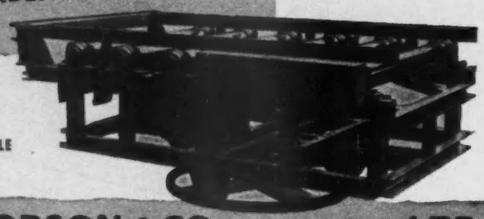

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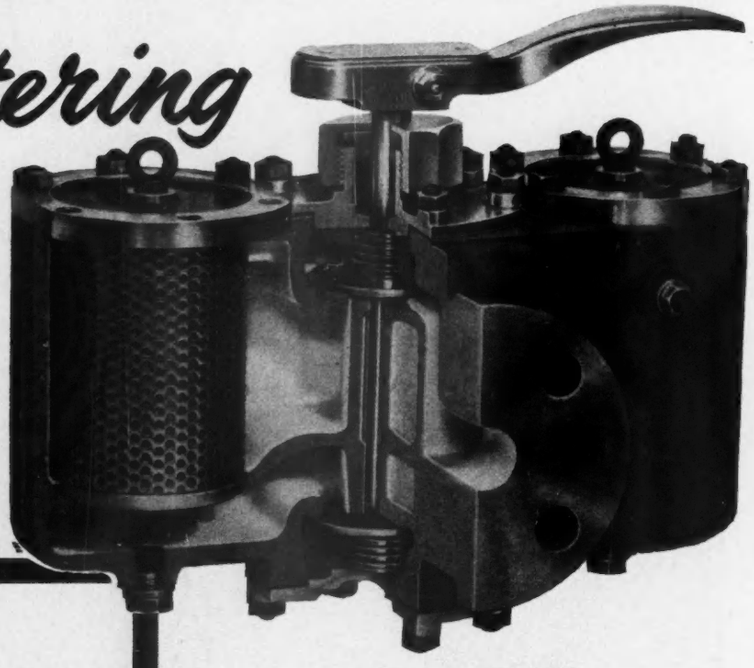

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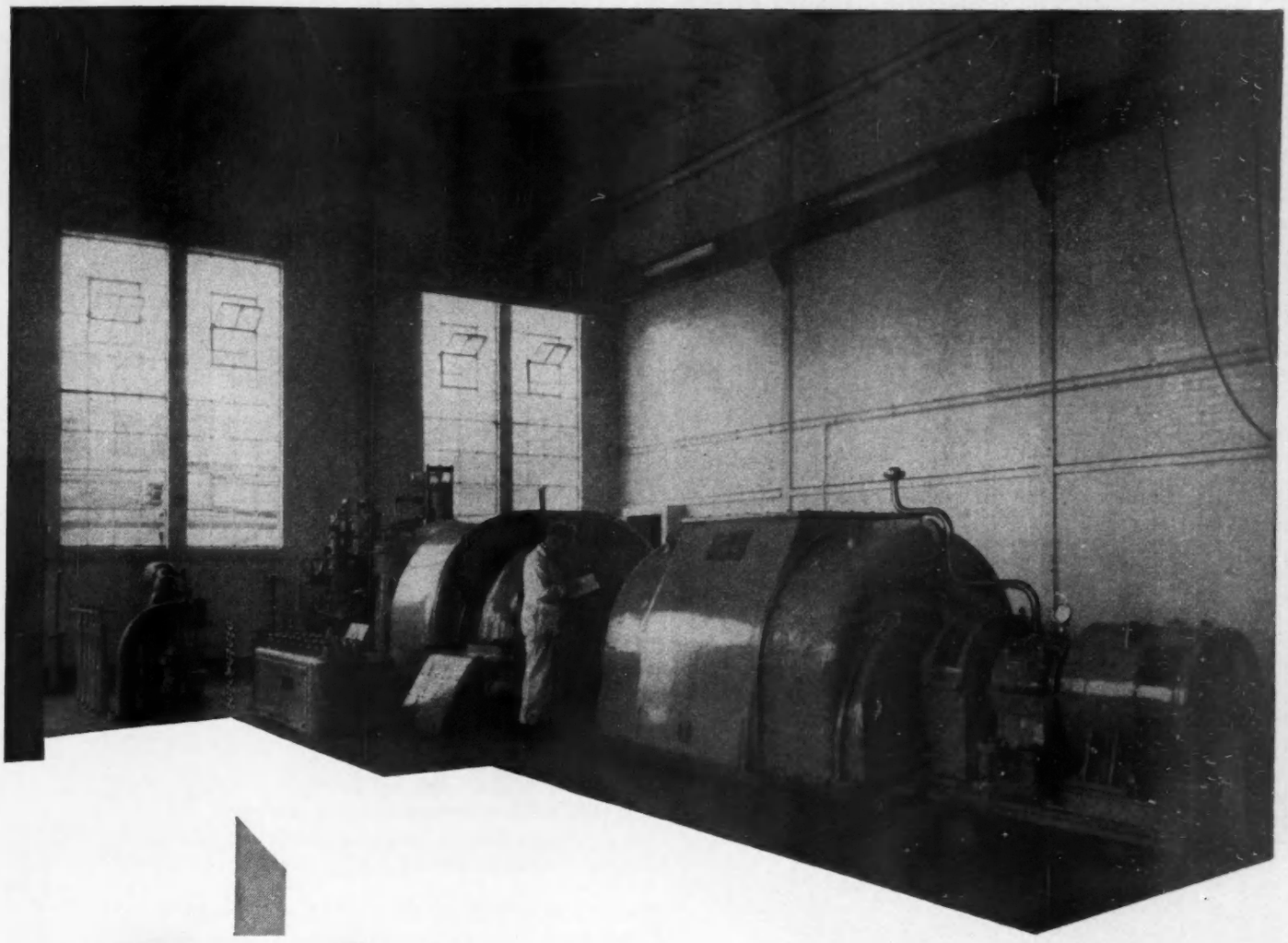

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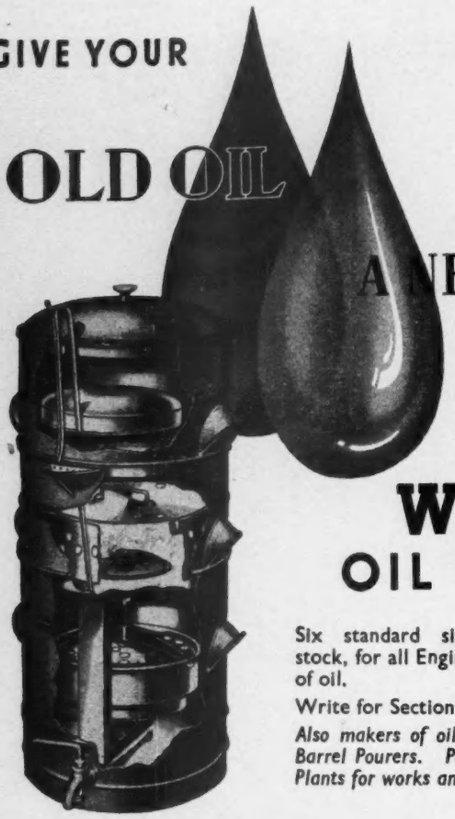

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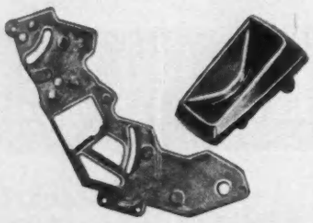

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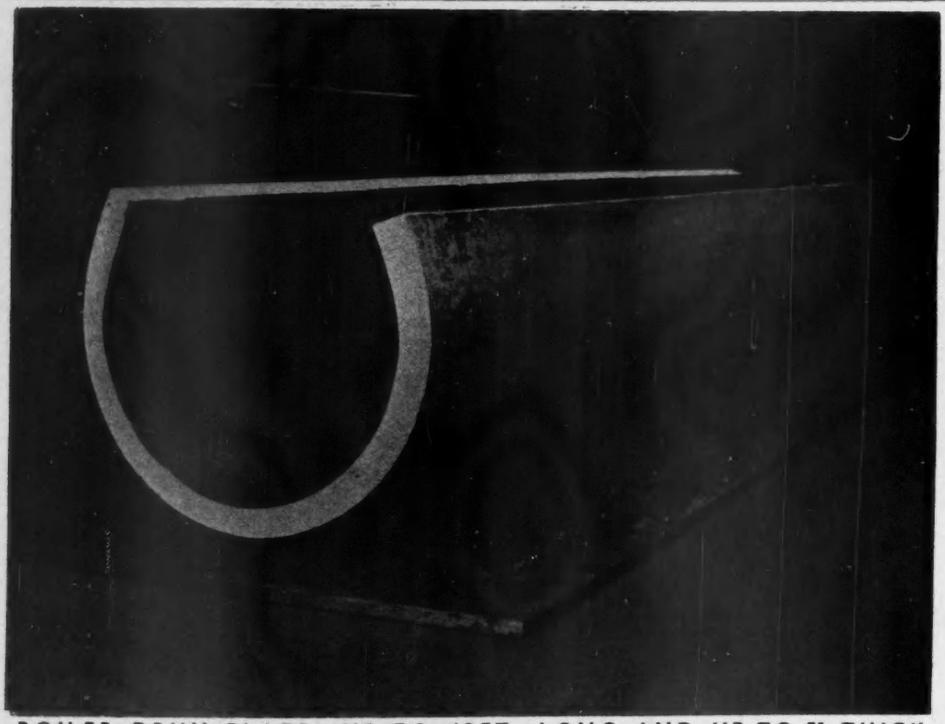

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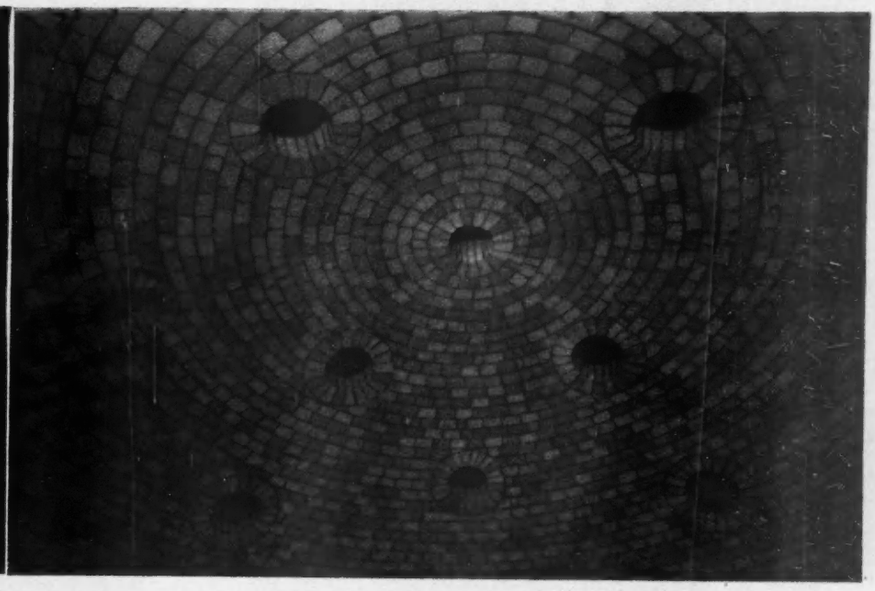

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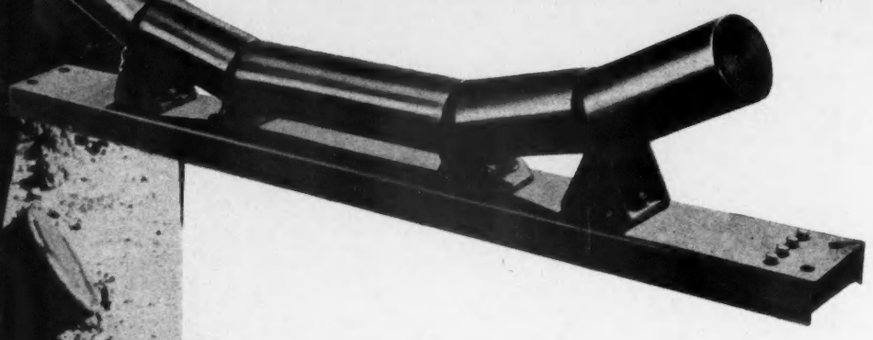

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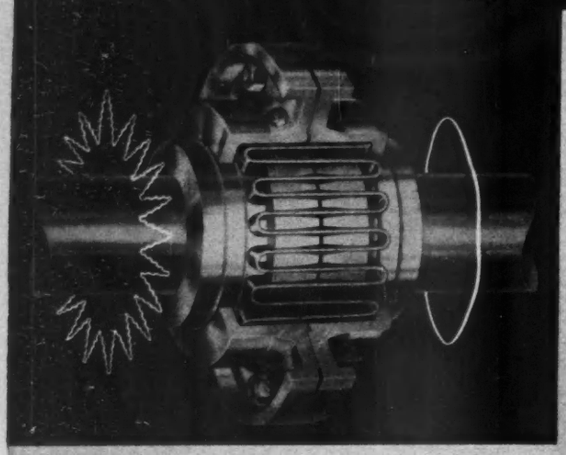

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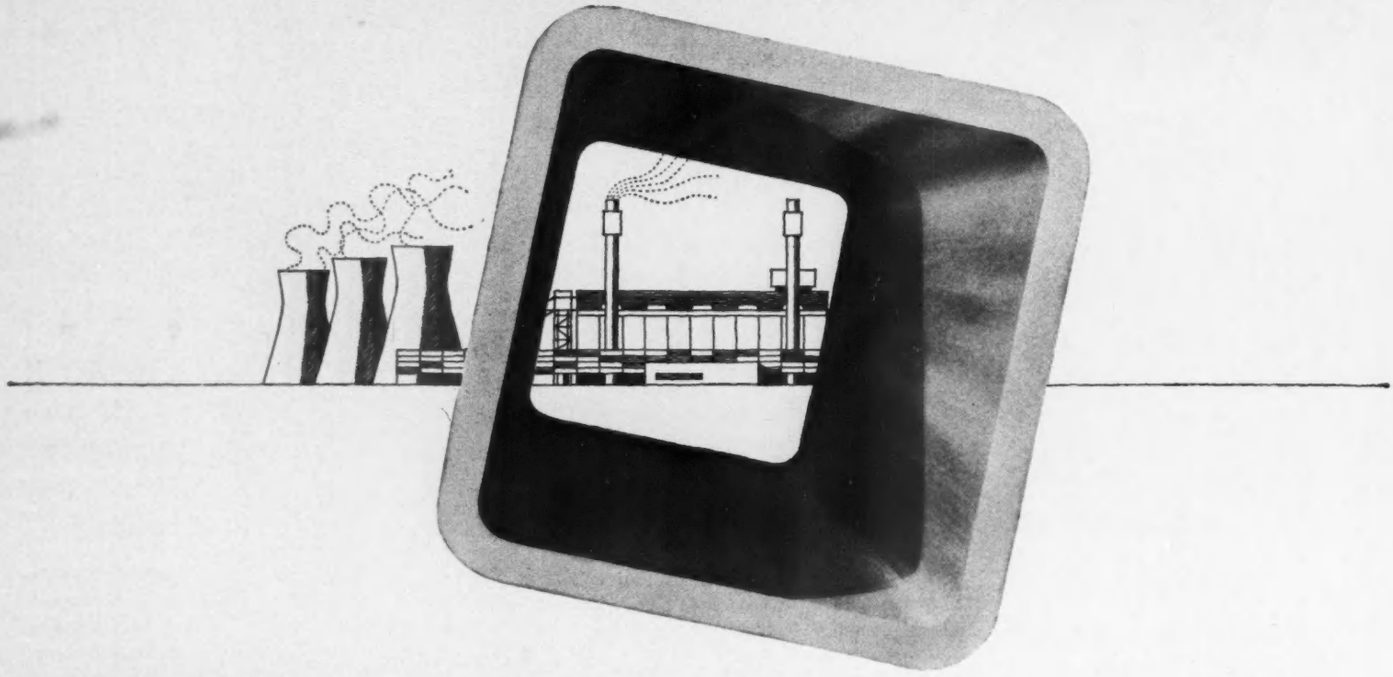

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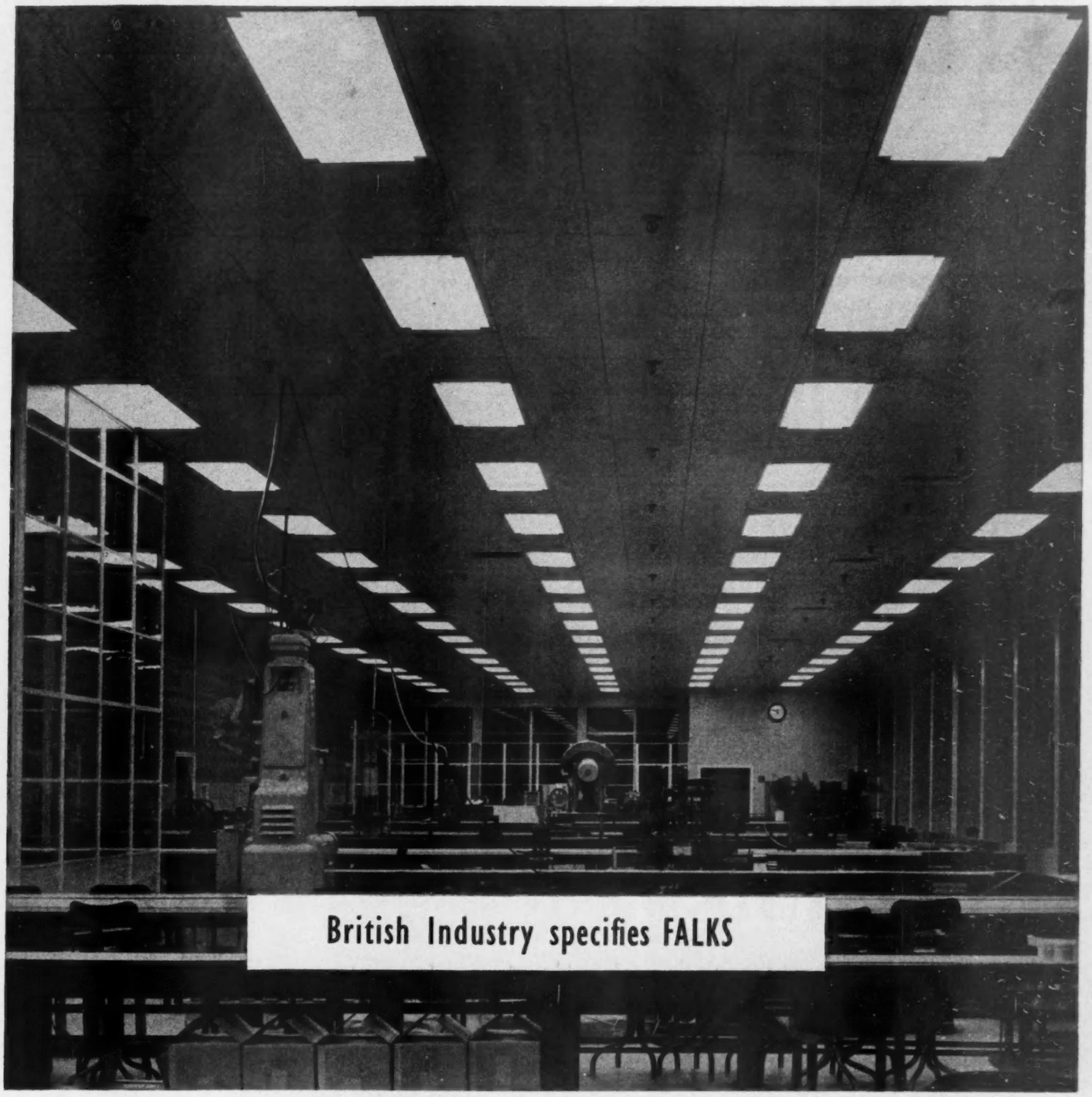

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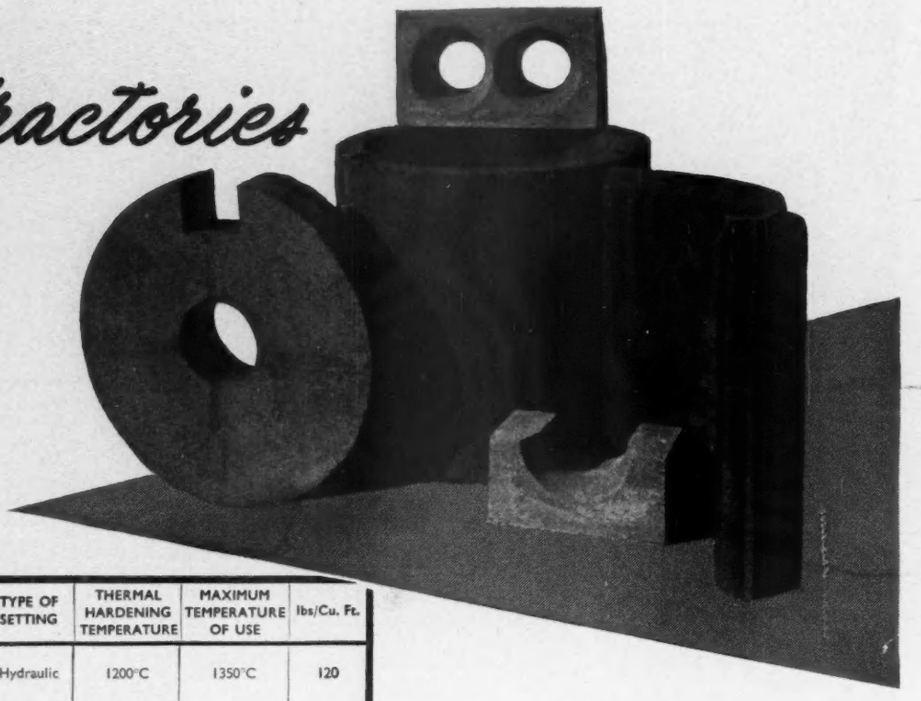

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